A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

MAY, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

1759. Density of Nuclear Energy Levels on the Oscillator Model. K. Umeda. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 757. *pp.* 197–204, *Feb.*, 1938. *In German.*—The density of the energy levels of a nucleus is calculated on the assumption that it consists of protons and neutrons moving independently in an elastic field of force. The constants are taken from the work of Volz and Dolch on the mass defects of light nuclei. The result is rather greater than the value estimated by Bethe from experimental data. R. P.

1760. Quantum Theory of Einstein-Bose Particles and Nuclear Interaction. N. Kemmer. *Roy. Soc., Proc.* 166*A*. *pp.* 127–153, *May* 4, 1938.—It is shown that there are four inequivalent but equally simple possibilities of formulating a field theory of Einstein-Bose particles, in which a positive expression for the energy density exists. Any of these formalisms might tentatively be accepted as a description of the "heavy electron." Considerations of relativistic invariance show that two independent expressions for the interaction of these particles with protons and neutrons can be chosen in each of the four cases. Taking account of the interaction terms the general Hamiltonian form of the theories is stated and the quantisation is performed. The resulting proton-neutron potential is determined and it is found that its sign and spin-dependence agree with reality in only one of the four cases, namely in the case based on the equations of Proca [see Abstract 4350 (1936)]. The (divergent) self-energies of the proton or neutron resulting from the interactions studied are evaluated. AUTHOR.

1761. Electromagnetic Properties of Nuclear Systems. W. E. Lamb, Jr. and L. I. Schiff. *Phys. Rev.* 53. *pp.* 651–661, *April* 15, 1938. —If it be supposed that a charge bearing field is responsible for nuclear forces, the charge and current of this field must be considered in describing the electromagnetic properties of nuclei. In this paper the authors discuss the extent to which these electromagnetic anomalies permit phenomenological description in terms of the charges and magnetic moments of the single heavy particles and the forces acting on them. They are guided in this discussion by the formalism of the electron neutrino field theory and that of the dynaton theory proposed by Yukawa. Apart from the known effect of exchange currents on electric dipole radiation, the most marked differences from the phenomenological treatment appear in the estimates of magnetic dipole radiation and magnetic spin dependent forces. The formalism used is developed in three Appendices:—(I) giving the proof of Serber's result on the repulsive nature of the field theoretic neutron-proton interaction in the deuteron; (II) considering the electric properties of heavy particles in more detail, and showing that Siegert's theorem, which connects the exchange current with the exchange interaction, is valid for the dynaton theory; (III) discussing more completely the magnetic properties of heavy particles. AUTHORS.

1762. Isotope Abundance and Atomic Weight of Rubidium. A. K. Brewer. *Am. Chem. Soc., J.* 60. *pp.* 691–693, *March*, 1938.—The abundance ratio of the isotopes of Rb in a variety of sources has been measured with the mass spectrograph and found to be $Rb^{85}/Rb^{87} = 2\cdot59$ to $2\cdot61$. Old micas containing Rb have been investigated for the isotopes of Sr; only Sr^{87} has been found. The effect of the radioactivity of Rb^{87} on the atomic weight of Sr is discussed. The atomic weight of Rb computed from the isotope ratios is 85·46. AUTHOR.

***1763. Mass Spectrograph of High Intensity and the Separation of the Isotopes of Rubidium. W. Walcher.** *Zeits. f. Physik*, 108. 5–6. *pp.* 376–390, 1938.—By means of a mass spectrograph of high intensity, whose separation characteristics are investigated, separation of the Rb isotopes Rb^{85} and Rb^{87} was effected. The individual isotopes were collected in a C cylinder, which on the completion of the collecting process served as the hollow kathode of a discharge. With about $90\mu g$ Rb^{85} or about $30\mu g$ Rb^{87} it is possible to investigate the hyperfine structure of the strong resonance line of Rb I. Thereby the separation of the isotopes is established and also the correctness of the assignment of the components of the hyperfine structure to the different isotopes. [See also Abstracts 354 (1931) and 4785 (1934).] A. W.

1764. Nuclear Isomers of In^{116}. A. C. G. Mitchell and L. M. Langer. *Phys. Rev.* 53. *pp.* 505–510, *April* 1, 1938.—The isomeric periods of In^{116} (13 sec. and 54 min.), produced by the capture of slow neutrons by In^{115}, have been studied with the purpose of determining the energy level scheme for In^{116}. The γ-ray of energy 1·4 eMV previously measured by the authors has been shown to have a period of 54 min. No γ-ray of 13 sec. period could be found. The percentage transmission by B of resonance neutrons which effect the two periods has been measured and found to be the same within the experimental error, for both periods. The value obtained for the percentage transmission of 0·0252 gm./cm.^{2} of B (uncorrected for obliquity) is $73\cdot5 \pm 3\cdot0$. The branching ratio R(13 sec.)/R(54 min.) has been shown to be independent of the method of excitation and has the value $1\cdot12 \pm 0\cdot06$. From the known β-ray end points and the energy of the γ-ray an energy level diagram has been drawn up which accounts for all the experimental facts. The two excited levels of In^{116} from which disintegration takes place are separated by 0·3 eMV, the level corresponding to the 13 sec. period lying higher. γ-Ray transitions between these two levels can be forbidden by choosing quantum numbers which differ by 5 units. AUTHORS.

1765. Numerical Valency in Polyatomic Molecules. H. Lessheim and R. Samuel. *Phil. Mag.* 25. *pp.* 667–677, *April*, 1938.—In this paper it is intended to show that tetravalency obtains from the ground level without any excitation at all of the *p* electrons, and hexavalency by excitation of one of the *s* electrons to the *p* shell without invoking the *d* orbital. London's statement as to the numerical valency of unexcited atoms is shown to be necessary and valid only for diatomic molecules, while in polyatomic ones, when the field possesses more than one preferential direction. Pauli's exclusion principle imposes different rules and affords an enhanced number of possibilities for uncoupled spin vectors. It is remarkable that valencies higher than three are never exhibited in diatomic, but are met with only in polyatomic molecules. The activation of the *s* electrons remains necessary and is supported experimentally likewise for di- and polyatomic molecules, but the *d* shell need not be invoked and the sulphur atom in polyatomic molecules is hexavalent with an electron configuration $3s3p^5$. There exists, therefore, no exception for the atoms of the second period, which do not possess a low *d* shell, and in polyatomic molecules nitrogen, for example, may exhibit pentavalency with an electron configuration $2s2p^4$. H. H. Ho.

1766. Distribution of Metallic Electrons in the Alkali Metals. P. Gombás. *Zeits. f. Physik*, 108. 7–8. *pp.* 509–522, 1938.—Previous work by the author [see Abstract 1887 (1937)] is continued on the calculation of the union of the more simple metals based on the Ritz approximation process, a method being now described for the evaluation of the eigenfunction of the valency electrons in the alkali metals and applied to metallic K. It has been found that outside the ion, and therefore in the largest part of the cell element, the eigenfunction is approximately constant. H. H. Ho.

1767. Structure of Electronic Shells of Diatomic Homopolar Molecules. W. M. Tschulanowsky. *Acta Physicochimica*, 8. 1. *pp.* 113–128, 1938. *In English.*—Electrons in the molecule are divided into three groups; (1) electrons near the nuclei not participating in the bond; (2) electrons not participating in the bond, but their state determined by the axial field of the molecule; (3) electrons constituting the bond, their state determined by the axial field and not being associated with either single nucleus. The model is applied to the classification of 44 known levels of 11 molecules with 12, 13, 14, 15 and 16 electrons. [See Abstract 4774 (1937).] H. G. C.

1768. Structures of B_2NH_7 and $B_3N_3H_6$ and of Dimethylamine. S. H. Bauer. *Am. Chem. Soc., J.* 60. *pp.* 524–530, *March*, 1938.—Triborine triamine, dimethylamine, and the newly discovered compound B_2NH_7 were studied by means of an electron diffraction experiment. The benzene-like structure of the first of these $(sym.\ D_{3h})^{18}$ was confirmed and the B–N distance found to be $1 \cdot 44 \pm 0 \cdot 02$ Å. The best values for the parameters of dimethylamine are: C–N $= 1 \cdot 46 \pm 0 \cdot 03$ Å, C–H $= 1 \cdot 08 \pm 0 \cdot 03$ Å; and the C–N–C angle $= 108 \pm 4°$. The arrangement of heavy atoms in B_2NH_7 was determined to be B–N–B, but the electron diffraction investigation could not eliminate definitely the configuration $H_3B–NH_2–BH_2$ in preference to $H_3B–NH–BH_3$. The mean B–N separation is $1 \cdot 56 \pm 0 \cdot 03$ Å and the B–N–B angle is tetrahedral to within four degrees. AUTHOR.

***1769. Mass Spectrometer with Improved Focusing Properties. W. Bleakney and J. A. Hipple, Jr.** *Phys. Rev.* 53. *pp.* 521–529, *April* 1, 1938.—The use of crossed electric and magnetic fields for a mass spectrometer is discussed. It is shown that this arrangement has perfect focusing properties; the focusing depends only on the *m/e* of the ion selected, and not on the velocity or direction of the charged particles entering the analyser. The projection of the path in the plane perpendicular to the magnetic field is a trochoid. The theory necessary for the design of the apparatus is developed in some detail. A method of drawing the trochoids is described as well as a chart which is a great help in rapidly correlating the many variables. It is shown that there are two types of path to be considered, the curtate and the prolate. The former was employed in the first model constructed and gave encouraging results in spite of some structural difficulties encountered. The second apparatus was of the prolate

type and worked exceptionally well. Some typical mass spectra are shown. It was found that a distribution in energy amounting to 50 % of the potential accelerating the ions had no effect on the resolution.
AUTHORS.

See also Abstracts 1801, 1802, 1879, 1961, 1977, 2033, 2036, 2045, 2086, 2171.

COLLOIDS.

1770. Preparation of Alumina Hydrosols. M. A. Miller. *J. Phys. Chem.* 42. *pp.* 419–426, *March*, 1938.—A simple method of preparing large quantities of alumina hydrosols, apparently in the absence of stabilising ions, is described. It is shown that alcohol-activated Al-Cu couples produce sols which settle to an apparent equilibrium stratification after a period of about 5000 hr. Preliminary experiments on other than the Al-Cu couple are described. A mechanism for the reaction of metallic couples with water is proposed. It is concluded that the vectorial properties attending a given substance, by virtue of the mode of its formation, are largely responsible for the subsequent characterisations which that substance displays during the course of its chemical history. [See also Abstract 443 (1937).]
AUTHOR.

1771. Absorption and Scattering of Light in Hydrophobic Colloids. Part III. F. B. Gribnau. *Kolloid Zeits.* 82. *pp.* 158–164, *Feb.*, 1938.—Continuing previous work [see Abstract 913 (1938)] the author carries out measurements on the lateral scattering of light in sols of Au, Se and mastic. For the highly dispersed sols good agreement is obtained with the theoretical formulæ of Mie. It is shown that the optical constants of the dispersed substances can be satisfactorily determined from observations on their colloidal solutions.
L. A. W.

1772. Viscosity of Highly Polymerised Compounds. I. Sakurada. *Kolloid Zeits.* 82. *pp.* 345–350, *March*, 1938.—At extremely low concentrations, where proportionality exists between the specific viscosity η_{sp} and the concentration c, a single constant suffices for the expression of the concentration-dependence of the viscosity of solutions of highly polymerised compounds. At fairly low concentrations, however, a single constant does not enable exact relationship between concentration and viscosity to be stated, and a series has to be employed so that as far as the terms of the first and second order are concerned, the relationship becomes $\eta_{rel} = 1 + a\,(\phi c/100) + b\,(\phi c/100)^2$, where a and b denote constants which are dependent on the form of the dissolved particles and ϕ is the specific volume.
H. H. Ho.

1773. Constitution of a Thermoreversible Gel. F. Hirata. *Chem. Soc., Japan, Bull.* 13. *pp.* 49–60, *Jan.*, 1938. *In English.*—A relation is derived theoretically between the dielectric constant of the intermicellar liquid and the rigidity of a thermoreversible gel and the relation has been examined using the results of measurements of rigidity of the gel of gelatin.
AUTHOR.

1774. Dilatometric Study of Colloidal Gels. A. Boutaric. *Comptes Rendus*, 206. *pp.* 675–677, *Feb.* 28, 1938.—A dilatometric method has been used to study the expansion of industrial fibro-resinous materials. The expansion depends on the amount of water included by the materials after their manufacture.
A. J. M.

1775. Intensity Distribution in the Fibre Diagram. Y. Go, S. Nagata and J. Kakinoki. *Chem. Soc., Japan, Bull.* 13. *pp.* 198–210, *Jan.*, 1938. *In German.*—The intensity distribution in the fibre diagram has been quantitatively investigated and an attempt made to derive a general mathematical function for the intensity distribution in the ideal spiral fibre structure. Such a function must include the intensity distribution for the ring fibre structure and the simple fibre structure as special cases, while on the other hand the diagram of the real fibre structure may be regarded as a superposition of many ideal spiral fibre structure diagrams. A formula has been derived on the above lines, and a systematisation of the different possible types of diagram has been based upon it. The formula itself is discussed alongside previous formulæ of Kratky, Sakurada-Hutino, and Matano, which while similar afford small deviations. For ordinary practical use, however, Matano's formula is recommended. H. H. Ho.

1776. Ratio of Electroosmosis to Electrophoresis. L. S. Moyer. *J. Phys. Chem.* 42. *pp.* 391–395, *March*, 1938.—The ratio of electro-osmotic to electrophoretic mobility of gelatin-coated surfaces is very near unity, even in gelatin solutions as dilute as 0·001 % and in the absence of added salt, if care is taken to ensure a complete coating. AUTHOR.

1777. Mobility Studies with Colloidal Silicic Acid. F. Hazel. *J. Phys. Chem.* 42. *pp.* 409–414, *March*, 1938.—An electrokinetic study of colloidal silicic acid is made with the aid of an ultramicroscope. The effect of electrolytes, pH, and of colloids of opposite sign on the mobility is investigated. [See also Abstract 3294 (1933).] AUTHOR.

1778. Adsorption in the Coagulation of Sols by Electrolytes. H. B. Weiser, W. O. Milligan and W. J. Coppoc. *J. Phys. Chem.* 42. *pp.* 427–435. *March*, 1938.—Coagulation of hydrophobic sols by electrolytes is due to a decrease of the electrokinetic (ζ) potential of the particles owing to contraction of the double layer. This is caused by adsorption of ions of opposite charge to those forming the inner portion of the double layer. Sols of hydrated oxides of Fe, Al, and Cr, As_2S_3, S, and $Cu_2Fe(CN)_6$ are completely coagulated at or below the point of maximum adsorption of the precipitating ion. The anomalous behaviour of AgI sols noted by Verwey and Kruyt has been investigated, and it is shown that for highly polydisperse sols the concentration of electrolyte required for complete coagulation in a given time may be considerably greater than that required to precipitate a large proportion of the sol. A. J. M.

1779. Structure of Thixotropic Systems. B. Tamamushi. *Chem. Soc., Japan, Bull.* 13. *pp.* 234–240, *Jan.*, 1938. *In German.*—Based on an investigation of the coagulation process, which was carried out with suspensions of a sodium-clay, it was established that thixotropic gelatinisation occurred as an intermediate stage between two extreme states, namely of partial lyophobic coagulation on the one hand and complete lyophilic flocculation on the other. In the case of concentrated thixotropic suspensions (greater than *ca.* 10 %), the theory of the lyosphere is satisfactory whereby far-reaching van der Waals forces are assumed between two particles. On the other hand, with thixotropic systems of smaller concentrations the structure is assumed to be that of a three-dimensional network. The conditions when the particles are anisometric and anisotropic, also support the theory of the structural formation of an oriented net work. When lyophobic non-thixotropic $BaSO_4$-suspensions are treated with small amounts of lyophilic sodium-clay, a thixotropic system is produced. H. H. Ho.

1780. Rhythmic Precipitation in an Electric Field. Part III. T. Okaya. *Phys. Math. Soc., Japan, Proc.* 20. *pp.* 110–119, *Feb.*, 1938.

In French.—Periodic precipitation in an electric field, illustrated more especially by the case of the interaction between $K_2Cr_2O_7$ and $AgNO_3$ in a vertical capillary tube between whose ends a p.d. is maintained, is discussed mathematically. The energy of precipitation of the Ag ion-molecule to form $Ag_2Cr_2O_7$ has approximately the value 17·8 kg.cal. The coefficient of diffusion, a, in the presence of a weak electric field, V, $(-6 < V < 6)$ is given by $a = a_0(1 + mV)^{-2}$. The mobility, k, of the Ag ions is given by $k = k_0(1 - mV)$. The ratio $\beta = l_n/\sqrt{t_n}$, where l_n and t_n denote respectively the position and time of formation of the n^{th} periodic precipitated layer is independent of n for small values of n. [See Abstract 412 (1938).] J. S. G. T.

1781. Structures of Living Materials. G. L. Clark. *Radiology,* 30. *pp.* 180–190, *Feb.*, 1938.—The author gives a summary of the results that have been obtained by X-ray analysis of biological substances. The results are classified under the headings, cellulose, chitin, rubber and proteins (fibrous and globular). J. I.

1782. Physical Properties of Protoplasm. E. N. Harvey. *J. of Applied Physics,* 9. *pp.* 68–80, *Feb.*, 1938.—A short survey is made of the present position of knowledge of cellular structure, with special reference to the physical problems involved in the investigation of that structure. The questions of cellular viscosity and surface tension are then considered in greater detail. For investigations in viscosity a centrifuge microscope is described. With this instrument it is possible to observe visually or photographically changes which take place in monocellular organisms during centrifuging. Results of many workers are examined and compared. Two methods for measuring surface tensions are described, the centrifuge method and the compression method, and the results compared. J. E. R.

1783. Optical Studies of the Molecular Organisation of Living Systems. F. O. Schmitt. *J. of Applied Physics,* 9. *pp.* 109–117, *Feb.*, 1938.—A review of recent investigations of the structure of living tissue (*e.g.*, nerve fibre) by polarised light and X-ray diffraction methods. C. B. A.

1784. X-Ray Spectra, Double Refraction and Viscosity of Sols in Motion. K. Hess, H. Kiessig and W. Philippoff. *Naturwiss.* 26. *pp.* 184–186, *March* 25, 1938.—The investigation of structural details of sols moving in laminar flow in capillary tubes or a Couette apparatus, by methods employing X-ray analysis, double refraction or viscosity determinations is discussed with a view to discriminating between the fields of usefulness of the respective methods. Double refraction is especially useful for revealing orientation of the particles and the character of the flow, but this latter is more convincingly deduced from viscosity determinations; X-ray analysis yields particulars relating to the fine structure, number, shape and orientation of the particles. J. S. G. T.

***1785. Ultracentrifuge and its Field of Research. T. Svedberg.** *Indust. & Engin. Chem.* (*Analytical Edition*), 10. *pp.* 113–127; *Disc.,* 128–129, *March* 15, 1938.—The development of the ultracentrifuge, which originated in some work on colloids done in Upsala about 1920 concerning particle size in Au sols, is first described and details of the oil-turbine instrument with diagrammatic illustrations are included. A short section on sedimentation follows and then a detailed account is given of ultracentrifuge measurements. With the aid of this instrument molecular weight determinations have been done from about 20,000,000 (tobacco mosaic virus) down to about 40 (LiCl). The technique developed offers the unique possibility of carrying out an analysis of the various molecular species or particle sizes present in a solution. The sedimentation constant is a very characteristic molecular property and, by means of it, it is shown possible to follow sensitive aggregation and dissociation reactions in many biological systems. Very full details are given with respect to an extensive series of protein investigations. Interesting discussions are contributed by **E. O. Kraemer** and **H. S. Taylor.** H. H. Ho

See also Abstracts 2009, 2010, 2169, and
1471B. Protection against Corrosion by Colloidal Graphite. F. Pavelka.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

1786. Forces Acting between Atoms and Ions and Physical Properties of Matter in Bulk. J. A. Wasastjerna. *Roy. Soc., Phil. Trans.* 237*A*. *pp.* 105–133, *March* 7, 1938.—A method is developed according to which it is possible to analyse, by the aid of accessible experimental data, the question of the dependence of the potential energy on the interatomic distance for atoms and ions with closed shells. The results of the analysis have been made the foundation for a theoretical calculation of a number of physical properties of crystals. In many instances the results of the calculations can be compared with experimental data. In other instances information is obtained concerning data, which have previously been entirely unknown or about which great uncertainty has prevailed. Finally, a theoretical interpretation is given to the empirical results. AUTHOR.

1787. Structure of Intermetallic Compounds of Rare-Earth Elements. A. Iandelli and E. Botti. *Gazz. Chim. Ital.* 67. 10. *pp.* 638–684, *Oct.*, 1937.—50% alloys of La, Ce, Pd with Zn, Cd, Hg are investigated by the powder method with Cu K radiation ($\alpha = 1\cdot359$ Å, $\beta = 1\cdot389$). The alloys with Hg are probably two-phase, the others have a body-centred cubic lattice. Charts reproduced for CeZn and CeCd show that a comparison of calculated and observed measurements of reflection intensities from various planes fully confirms this result. Values for *a* in Å are—LaZn $3\cdot75_2$, CeZn $3\cdot69_7$, PrZn $3\cdot67_1$, LaCd $3\cdot89_7$, CeCd $3\cdot85_7$, PrCd $3\cdot82_2$. The Goldschmidt atomic radius criterion is satisfied very well by these figures. [See also Abstract 932 (1938).] D. R. H.

1788. Order-Disorder Transformations in Alloys. F. C. Nix and W. Shockley. *Rev. Modern Physics,* 10. *pp.* 1–71, *Jan.*, 1938.—A detailed critical review from a physico-mathematical point of view, of work done between 1916 and 1938, with a Bibliography of 127 references. In the first portion the theories of Bragg and Williams, and of Bethe, the energy *versus* entropy representation, and Kirkwood's method are treated. In the second portion equilibrium theories for alloys of arbitrary composition are discussed under the heads—(1) energy of formation, (2) dependence of critical temperature on composition, (3) phase diagrams for the phenomenon, (4) treatments not using the nearest-neighbour assumption, (5) thermodynamic potentials of ordered phases. In the third portion theories for alloys not in equilibrium are treated from the standpoint of time of relaxation, and theory of temperature hysteresis. In the fourth part the idealised theory is adapted to the case of actual alloys from the standpoint of the origin of the ordering energy and the effect of lattice vibrations. The second half of the paper deals with the experimental properties of superstructures under the heads—(1) measurements of energy content, (2) Curie point of long-distance order as a function of composition, (3) ordered structures, (4) phenomena indicating the degree of order,

(5) behaviour of alloys not in equilibrium, (6) influence of order and composition on resistivity, (7) effect of order on mechanical properties, (8) effect of plastic deformation on order, (9) effect of order on magnetic properties, (10) criteria for the existence of order. Finally the author summarises the actual mathematical treatments under the heads—1. Simplification of the Nearest Neighbour Energy Expression and Energies of Formation. 2. Bethe's First Approximation. 3. Free Energy in Terms of Thiele's Semi-Invariants. 4. Kirkwood's Method. 5. The Entropy-Energy Curve from the Free Energy. D. R. H.

1789. Quantitative Measurements of Texture by the Magnetic Torque Method. L. P. Tarasov. *J. of Applied Physics,* 9. *pp.* 192–196, *March,* 1938.—Magnetic torque measurements offer a possibility of specifying texture in ferromagnetic materials in a quantitative fashion and several methods have been proposed for accomplishing this. The method of Akulov and Brüchatov [see Abstract 1207 (1933)], although formally correct, is shown to be so restricted by its assumptions as to be inapplicable even to the commonest texture. A method proposed by Bitter, involving root-mean-square deviations from some mean orientation, is found to fail in practice because of the uncertainty in the measurement of the magnetic magnetic energy. A modification of this method, in which X-ray data are used to establish a relationship between two of the root-mean-square deviations, gives results in fair agreement with the pole figure of a cold-rolled Fe-Si alloy. AUTHOR.

1790. X-Ray Study of the Superlattice in Certain Alloys. E. A. Owen and I. G. Edmunds. *Phys. Soc., Proc.* 50. *pp.* 389–397, *May* 1, 1938.—Superstructures in the β phases of Ag-Zn and Au-Zn alloys submitted to various heat treatments have been investigated. Whereas in the Au-Zn alloys the atoms were found in ordered arrangement both in quenched specimens and in specimens maintained at temperatures up to the melting points of the alloys, in the Ag-Zn alloys ordered arrangement of atoms in the lattice was found only in quenched alloys. The results obtained are discussed in the light of the theory of order and disorder in alloys, put forward by Bragg and Williams. AUTHORS.

1791. Debye-Scherrer Photographs of Liquid Helium. W. H. Keesom and K. W. Taconis. *K. Onnes Lab., Leiden, Comm. No.* 252*c. Physica,* 5. *pp.* 270–280, *April,* 1938. *In English.*—These photographs were taken at 2·5° and 1·6° K for HeI and HeII respectively, with horizontal jets of He (even the thinnest glass giving a more distinct pattern than the He). Exposures were 5–8 hr. For HeI the diffraction rings were those of an ordinary liquid with simple spherical molecules. For HeII results did not confirm the diamond lattice hypothesis of London and Fröhlich [see Abstract 4610 (1937)], but are better explained by a structure derived from a face-centred cubic lattice by omitting half the number of atoms, space group T_d^2 with 16 atoms in the unit cell. The "holes" thus resulting explain the high thermal conductivity, as in the cases of AgI and $Ag_2Hg_2I_4$. C. A. S.

1792. X-Ray Structure of Pentaerythritol, $C(CH_2OH)_4$. I. Nitta and T. Watanabé. *Chem. Soc. Japan, Bull.* 13. *pp.* 28–35, *Jan.,* 1938. *In English.*—Above the transition point (179·5°) the central C atoms form a cubic face-centred lattice with $a = 8{\cdot}963$ Å, the shortest distance between these C atoms being 6·338 Å. No single fixed arrangement of the rest of the molecule explains the observations; the molecule becomes more or less non-rigid, rotating, but not quite freely, about the

C–C bonds with probably two preferred arrangements. The molecular state approaches that of a liquid, as implied by the fact that the heat of transition is much greater than that of actual fusion. The change from tetragonal to cubic does not begin to occur gradually below the transition temperature. C. A. S.

1793. Structure of Liquid Metals near Crystallisation Point. V. J. Danilow and J. V. Radtschenko. *Phys. Zeits. d. Sowjetunion,* 12. 6. *pp.* 745–755, 1937. *In German.*—Sn, Bi and Pb are examined in the liquid state by X-ray diffraction, microphotometer records of the resulting photographs being made. It is concluded that, within a small range, the crystalline arrangement of the metal persists after melting. J. T.

1794. X-Ray Examination of Liquid Metallic Eutectics. V. J. Danilow and J. V. Radtschenko. *Phys. Zeits. d. Sowjetunion,* 12. 6. *pp.* 756–760, 1937. *In German.*—By X-ray examination of the liquid eutectics in the systems Bi-Sn, Sn-Pb, Pb-Bi and Sn-Zn it is shown that the interatomic forces, which determine the structure in the solid state, also influence the atomic distribution in the liquid state. J. T.

1795. Anisotropy in Rate of Growth of New Nuclei During Recrystallisation. Part II. M. Kornfeld and F. Rybalko. *Phys. Zeits. d. Sowjetunion,* 12. 6. *pp.* 658–666, 1937. *In English.*—In the recrystallisation of plastically deformed single crystals of aluminium, new grains develop with anisotropic velocity. The new grains have the form of parallelepipeds bounded by octahedral planes of the mother crystal. They join on to the mother crystal with different irrational planes. The anisotropy of the growth velocity occurs in a comparatively narrow temperature range and vanishes at high temperatures. [For Part I see Abstract 4416 (1934).] AUTHORS.

1796. Mixed Crystals in System $KClO_3$–$KMnO_4$. Part II. H. Seifert. *Zeits. f. Krist.* 99. 1. *pp.* 16–26, 1938.—Buckley, in a recent paper [see Abstract 4304 (1937)], has stated the laws of association which govern the parallel growths obtained from mixed saturated solutions of $KClO_3$ and $KMnO_4$. The present author discusses these mixed crystals from the point of view of growth kinetics and regards the coalescence as anomalous mixed crystal formation. [For Part I see Abstract 1916 (1937).] J. I.

1797. Surface Phenomena in Crystallisation of Under-Cooled Liquids in Thin Layers. Part II. G. L. Michnewitsch and I. E. Browko. *Acta Physicochimica,* 8. 1. *pp.* 103–112, 1938. *In German.*—In Part I [see Abstract 2921 (1937)] the authors discussed the effect of an electric field on the appearance of crystallisation nuclei. In the present paper the observations are extended to the influence of a magnetic field on the distribution of crystallisation nuclei in thin layers of a diamagnetic substance (betol). Curves are reproduced showing the distribution of nuclei when the magnetic field is parallel and when it is normal to the specimen. In the case of fairly thick layers ($d = 0{\cdot}48$ mm.) it is found that when the field is parallel to the layer the nuclei are almost entirely near the limiting surfaces whereas there is a more uniform distribution when the field is normal to the specimen. J. I.

1798. Compressibilities of Fourteen Substances to 45,000 kg./cm^2. P. W. Bridgman. *Am. Acad., Proc.* 72. *pp.* 207–225, *Jan.,* 1938.—A method previously employed [see Abstract 4810 (1937)] for the study of transitions is modified by plotting the motion of the piston at constant temperature as a function of the pressure. Approximate data are reported and discussed for Li, Na, K, Rb, Cs, Ca, Sr, Ba, In, Sn, Pb, S, CO_2, and NaCl. [See following Abstract.] N. M. B.

1799. Polymorphic Transitions up to 50,000 kg./cm^2. of Several Organic Substances. P. W. Bridgman. *Am. Acad., Proc.* 72. *pp.* 227–268, Jan., 1938.—Investigations previously reported [see Abstract 4810 (1937)] are extended to the following substances for which data are given and discussed: CBr_4, CHI_3, cyanamide, urea, thiourea, ammonium thiocyanate, nitro-guanidine, ammonium formate, urea nitrate, methylamine hydrochloride, semicarbazide hydrochloride, dichloroacetamide, iodoacetic acid, oxamide, acetamide, guanidine sulphate, quinone, *p*-dichlorobenzene, dichlorophenol, hydroquinone, *p*-toluidine, naphthalene, *d*-camphor, menthol, and aniline sulphate. Six substances, dealt with in the paper, gave negative results, and shearing measurements for 9 other substances are summarised. [See preceding Abstract.] N. M. B.

***1800. X-Ray Photography of Reciprocal Lattice Planes.* W. F. de Jong and J. Bouman.** *Physica,* 5. *pp.* 220–224, *April,* 1938. *In German.*—The method previously described [see Abstract 1412 (1938)] is discussed further and several disadvantages are overcome. J. T.

See also Abstracts 1816, 1866, 1880, 1967, 2050, 2071, 2086, 2095, 2100, 2126, 2141, 2170, 2176.

DENSITY.

1801. Molecular Weights of Gases by the Method of Limiting Densities. E. Moles. *Arch. des Sciences,* 20. *pp.* 59–65, *Jan.–Feb.,* 1938.—The determination of molecular weights of gases by the method of "limiting densities", due to D. Berthelot, is based on the assumption that, since the well-known gas laws may be considered to be rigorously followed at very low pressures, the molecular weights of gases are proportional to their limiting densities. Values of the limiting density of a gas and of O_2 are derived from density measurements made under identical conditions between pressures of 0·5 and 1·0 atm., and from these the molecular weight of the gas is calculated by accepting the conventional value of 32·000 for O_2. An outline is given of the essential technique for achieving a precision of about 1 part in 100,000 which is attainable by the method. The gases studied include CO_2, N_2O, CO, N_2, NH_3 and SiF_4; confirmation is found for the isotopic ratios in C and N as determined by Aston, and evidence is given to show that the present international value for the atomic weight of Si is low. H. B.

1802. Determination of Molar Weights of Vapours near the Boiling Point. J. D. Ingle and H. P. Cady. *J. Phys. Chem.* 42. *pp.* 397–407, *March,* 1938.—The Dumas method of determining molar weights from vapour density measurements has been improved upon so that molar weights may be determined at the boiling point. The molar weights of water, D_2O, and several aliphatic alcohols have been determined at their boiling points. The heats of vaporisation of the above substances have been determined by use of the molar weights at the boiling points and of vapour pressure data. AUTHORS.

DIFFUSION AND OSMOSIS.

1803. Diffusion Processes in Living Systems. M. H. Jacobs. *J. of Applied Physics,* 9. *pp.* 81–87, *Feb.,* 1938.—An attempt is made to review the present position of experimental evidence on diffusion processes through the boundaries of living cells. Owing to its extreme simplicity the erythrocyte is chosen for detailed consideration. The general properties of the plasma membrane are explained from three points of view, permeability of the membrane to lipoid soluble substances, permeability to substances of low molecular volume, and the differential permeability to the anions and kations of inorganic electrolytes. The first two apply more or less universally to living cells, whilst the third is peculiar to erythrocytes. The effects of the presence of the non-diffusing hæmoglobin on the diffusion properties of the cell are described, together with the actions of external agents. J. E. R.

ELASTICITY AND PLASTICITY.

1804. Subdivision of a Solid Body. L. Lecornu. *Comptes Rendus*, 206. *pp.* 705–709, *March* 7, 1938.—Inside a solid body which is in equilibrium under the action of external forces there may exist surfaces at every point of which the stresses are zero. If so, the two parts into which the surface divides the body may be regarded as two independent bodies separated by an infinitely small distance. Proof is given that a solid of any shape may be so subdivided by means of a series of plane parallel surfaces, provided an appropriate set of external forces is applied. The special cases of the subdivision of an ellipsoid both stationary and rotating are considered. **Errata.** *ibid. p.* 1064, *March* 28, 1938. J. P. A.

1805. Modified Theory of Elasticity. W. E. Lilly. *Engineering*, 145. *pp.* 279–280, *March* 11, 1938.—The modification consists in the assumption of no volume changes in strained material, and some simple problems are worked out on this hypothesis. W. G. B.

1806. Molecular Processes at the Elastic Limits. A. Smekal. *Phys. Zeits.* 39. *pp.* 228–230, *March* 15, 1938.—The subject is briefly reviewed in the present paper under five sections as follows: §1 very shortly considers the idea of the elastic limits of a solid body and the structural changes involved. In §2 previous ideas on the nature of the initiation of plasticity are considered, and the absence or presence of finite elastic limits are ascribed to the macroscopic criterion for the distinction between amorphous glasses and crystalline solids. §3 contains a discussion of the stress conditions in relation to the molecular processes, and this is continued in §4 by means of a model crystal and the colour phenomena afforded by stress variations. In §5 and §6 double refraction variations are described for the model crystal. It is found that it is equally difficult to correlate a finite elastic limit with the entrance of irreversible molecular processes in crystalline substances as in solid glasses. H. H. Ho.

1807. Applications of the Galerkin Method to the Torsion and Flexure of Cylinders and Prisms. W. J. Duncan. *Phil. Mag.* 25. *pp.* 634–649, *April*, 1938.—The paper shows that the Galerkin method can be readily applied to the St. Venant torsion problem and to the St. Venant problem of the flexure of a cantilever under tip load. The following three cases of torsion are treated in detail: (*a*) Cylinder of aerofoil section; (*b*) cylinder of parabolic lenticular section; (*c*) rectangular prism. It is shown that the solutions obtained by the Galerkin method agree closely with those obtained otherwise. A simple formula for the torsional stiffness of a cylinder whose section is narrow and symmetrical, but otherwise arbitrary, is obtained. This formula is accurate in the case of an elliptic cylinder. It is shown that the shearing stresses in the flexure problem and the position of the flexural centre can easily be found, and applications are made to the elliptic cylinder and to a cylinder of aerofoil profile. The paper is preceded by a note on the Galerkin method [*ibid. pp.* 628–633]. AUTHOR.

1808. Accurate Calculation of the Deflection of Beams and Struts. T. Pöschl. *Phil. Mag.* 25. *pp.* 678–682, *April*, 1938.—Remarks on a paper by Jeffcott. [See Abstract 2246 (1932).]

1809. Effect of Pressure upon the Elastic Parameters of Isotropic Solids, according to Murnaghan's Theory of Finite Strain. F. Birch. *J. of Applied Physics*, 9. *pp.* 279–288, *April*, 1938.—Murnaghan's theory of finite deformations is applied to a discussion of the effect of hydrostatic pressure upon the elastic coefficients of an isotropic body, for small strains superposed on the hydrostatic strain. Stress-strain equations for the small strains, and the equations of small motion, are shown to have the same form as those of the classical theory, with elastic parameters which depend upon the pressure. Using a form of elastic potential identical with that of the classical theory, explicit results are found for the pressure coefficients of compressibility, Young's modulus, rigidity and so on; these are compared with such experimental results as are available, with good agreement. A single-constant formula is derived which gives the volume change of such compressible materials as sodium and caesium up to the highest experimental pressure, 45,000 kg./cm^2., within the experimental error. AUTHOR.

1810. Adiabatic Compressibility of Liquids. J. Villey. *Comptes Rendus*, 206. *pp.* 655–658, *Feb.* 28, 1938.—A mathematical analysis is made of the indirect method whereby the dynamic compressibility at high pressures is measured through a study of the motion of a piston fitted to a cylinder of the liquid when a known impulse is given to the piston. It is assumed that, to a first approximation, the variation of the density of the liquid is a linear function of the impulse applied. N. M. B.

1811. Influence of Temperature and Pressure on the Volume and Refractive Index of Benzene. R. E. Gibson and J. F. Kincaid. *Am. Chem. Soc., J.* 60. *pp.* 511–518, *March*, 1938.—The authors have measured the compressions of benzene to different pressures up to 1250 bars at temperatures between 25° and 65°. The compressions are well represented by the Tait equation and the constant C in this equation is independent of temperature. P.V.T. relations and derived quantities are computed with considerable precision over this range of pressure and temperature. The temperature variation of the constant B in the Tait equation has been studied and B has been fitted into an equation of state of the van der Waals type. The results indicate that B is the difference between the a/v^2 and $RT/(v-b)$ attractive and repulsive forces in the liquid. By matching the refractive indices of benzene under different conditions against those of optical glasses, the change of the refractive index of benzene with pressure is estimated with considerable accuracy. The results confirm the empirical worth of the Eykman specific refraction formula and show that with this formula the compressibility of benzene may be computed from refractive index-pressure measurements almost as accurately as it may be measured directly. AUTHORS.

1812. Theory of Plastic Deformation and Twinning. J. Frenkel and T. Kontorowa. *Phys. Zeits. d. Sowjetunion*, 13. 1. *pp.* 1–10, 1938. *In English.*—An elementary scheme of the process of plastic deformation or twinning is proposed, consisting in a caterpillar-like motion of one atomic chain over another (supposed to remain fixed). The velocity of slip-propagation is calculated and found to be a function of the energy, approaching the velocity of sound with increase of the latter but never exceeding it. A generalisation of the theory to three dimensions is pointed out. AUTHORS.

1813. Supersonic Measurement of Elastic Constants of Solids. A. Walti. *Helv. Phys. Acta,* 11. 2. *pp.* 113–139, 1938. *In German.*—A previous paper by R. Bär and A. Walti [see Abstract 4837 (1934)] describes the principle of a method of determining the elastic constants of isotropic solids. In order to determine the elastic constants of the body the wave-length of compression and transverse waves of known frequency must be known. In the present paper an improved experimental arrangement is described by means of which the transmission maxima through a sheet of glass are determined for perpendicular and oblique incidence in the frequency range 10^6–10^7 ~. From these measurements the wavelength of compression and longitudinal waves is deduced by means of a theory of H. Reissner [see following Abstract]. The values of these velocities are independent of the angle of incidence and the thickness of the sheet; the elastic coefficients deduced, namely, Poisson's ratio, Young's modulus and the torsion modulus, agree within the limits of error with the usual static values. K. M. C.

1814. Transmission of Compression Waves through a Solid Plate Immersed in a Fluid. H. Reissner. *Helv. Phys. Acta,* 11. 2. *pp.* 140–155, 1938. *In German.*—Assuming plane compression waves falling on a parallel-sided plate in which there is no internal friction, the author deduces an expression for the transmission, *i.e.* the ratio of the squares of the amplitudes of the incident and emergent waves. This expression is a function of the angle of incidence, the angles of refraction in the plate, the wave-lengths, and the velocities of both compression and torsional waves in the plate. It is useful in determining the elastic constants of the plate. Its possible value in the theory of the sound-insulation of walls is pointed out. [**Erratum,** *ibid.* 11. 3. *p.* 268, 1938.] K. M. C.

1815. Photoelastic Determination of Stresses Around a Circular Inclusion in Rubber. W. E. Thibodeau and L. A. Wood. *Bureau of Standards, J. of Research,* 20. *pp.* 393–409, *March,* 1938.—Analysis is made of the stresses around a rigid circular inclusion with cemented boundary in a rubber sheet which is under simple tension at a distance from the inclusion. The analysis is performed by the photoelastic method, in which data are obtained from observations of the changes produced in a beam of polarised light passing through the transparent model. The fundamental principles of the method and a detailed account of their application are given. The possibilities of the use of rubber as a model material are demonstrated. The stress-optical coefficient of a certain soft vulcanised rubber compound is found to be 2030 brewsters, which is in agreement with the results of previous work. The maximum stresses near the boundary of the disc are found to be about 50% greater than the average applied stress. The experimental results are compared with those given by a theoretical treatment of this problem, and quite satisfactory agreement is obtained. AUTHORS.

1816. Structure of Steel at Fracture. H. J. Gough and W. A. Wood. *Roy. Soc., Proc.* 165*A. pp.* 358–371, *April* 14, 1938.—In continuation of previous work [see Abstract 2529 (1936)], the authors have studied, by the fatigue method of testing, combined with X-ray analysis, the crystalline structure at fracture of mild steel normalised, and brought to a fragmented condition by cold-rolling. With normalised steel it is found that repeated cycles of a safe range of stress do not, *as* fatigue stresses, produce any appreciable effect on the crystalline structure; directly the safe range of stress is exceeded, however, a complete modification of structure results. The *rate* of deterioration of structure, due to an unsafe range of stress, decreases as the test progresses until a stable state is approached but not quite reached; the rate of deterioration accelerates during the last stage of the test and fracture results. Fragmentation is essentially of the nature of a strengthening effect, assisting the material to resist further changes. With cold-rolled steel no structural changes whatever are detected under safe stress ranges. Under unsafe ranges of stress, however, the material gives an X-ray spectrum consisting of a continuous ring. As the test proceeds there is no evidence of further break-up of the crystallites nor any evidence of a state of preferred orientation; heavy lattice distortion occurs in the crystallites. The fracture stage represents the incidence of a condition of severe internal stress in the fragmented material. J. S. G. T.

See also Abstracts 1798, 1799, 1881, 2013, 2100, and
1475B. Deformation and Fracture of Metals. H. J. Gough and W. A. Wood.
1476B. Determination of Principal Stresses from Photoelastic Data. M. M. Frocht.
1515B. Photoelastic Materials. G. H. Lee and C. W. Armstrong.

GRAVITATION.

1817. Stokes' Formula in the Theory of Gravitation. G. Garcia and A. Rosenblatt. *Comptes Rendus,* 206. *pp.* 423–425, *Feb.* 7, 1938.—A mathematical note on the replacement of the Newtonian potential of a solid body by the potential of a surface layer. W. S. S.

HYDRODYNAMICS AND AERODYNAMICS.

1818. Equilibrium of a Ball Supported by a Vertical Air-Jet. G. D. Yarnold. *Phys. Soc., Proc.* 50. *pp.* 385–388, *May* 2, 1938.—Experiments on the equilibrium of a ball supported by an air-jet are described. The forces acting on the ball are obtained from pressure-distribution curves. AUTHOR.

1819. Stream Flow. G. Nebbia. *Accad. Lincei, Atti,* 26. *pp.* 433–439, *Dec.* 19, 1937.—The conception of the " total quantity of motion " in stream flow is applied to a number of cases of free flow with gradual change, but the results can be applied to problems involving a sudden change of flow. W. A. R.

1820. Transverse Waves in Canals. B. R. Seth. *Indian Acad. Sci., Proc.* 7*A. pp.* 104–107, *Feb.,* 1938.—This paper contains a non-rigorous proof that in an infinitely long canal whose cross-section has a perimeter whose equation is of the form $\Sigma(-1)^n a_{2n+1}[\sin(2n+1)\theta]/r^{2n+1} = 1$, (where the highest point is the origin and the vertical line of symmetry is $\theta = \frac{1}{2}\pi$), and which is partially filled with water, there are no stable transverse oscillations for which the condition at the free surface is satisfied. S. G.

1821. Decay of Circular Waves on Water. J. Baurand. *J. de Physique et le Radium,* 9. *pp.* 69–72, *Feb.,* 1938.—Values of β in the expression $A = ae^{-\beta r}/\sqrt{r}$, were determined, where A is the amplitude of a circular wave of sinusoidal form at a distance r from the source. Attention is given to the probable accuracy of the measurements, to the form of the waves, and to the effect of the surface condition of the cylinder by means of which the waves were formed. An expression is given for the relation between the viscosity of the liquid and β, but values determined on this basis for the viscosity of water between 13° C. and 22° C. are about 15% too small, though they show approximately the correct temperature coefficient. P. H. B.

1822. Force on an Elliptic Cylinder Moving in a Liquid Endowed with Uniform Vorticity. Y. Tasiro. *Phys. Math. Soc., Japan, Proc.* 20. *pp.* 91–99, *Feb.*, 1938. *In English.*—The undisturbed motion of a uniform incompressible inviscid fluid being represented, relative to fixed axes by $u = -2\omega By$, $v = 2\omega Ax$ (with $A + B = 1$) so that the vorticity is constant, the author finds formulæ for the force and moment on an elliptic cylinder at any orientation relative to the fixed axes and moving in any manner through the fluid. S. G.

1823. Motion of an Elliptic Cylinder in a Converging Stream. S. Oka. *Phys. Math. Soc., Japan, Proc.* 20. *pp.* 105–109, *Feb.*, 1938. *In English.*—The two-dimensional motion of an elliptic cylinder in a converging stream of incompressible, perfect fluid, whose velocity potential is given by $\phi_0 = -U_0x + C(y^2 - x^2)/2$, is discussed. Expressions are derived for the velocity potential of the motion round the cylinder, the pressure at any point in the fluid and the resultant moment about the centre of the ellipse. The equilibrium of a very flat elliptic cylinder in the stream is discussed. J. S. G. T.

1824. Practical Application of the Analogy between Supersonic Flow in Gases and Supercritical Flow in Open Channels. T. v. Kármán. *Zeits. f. angew. Math. u. Mechanik*, 18. *pp.* 49–56, *Feb.*, 1938.—It was found at Los Angeles that the increase of height of the water at the outer wall of a curved channel was considerably greater than that calculated statically from gravity and centrifugal force, especially when a considerable volume of water had to be led away in a short time. The abnormal increase of height of the water surface is due to the occurrence of supercritical velocities, *i.e.*, velocities greater than that of waves of tidal type in the channel. Experiment showed a system of waves crossing the surface of the channel and giving to the lines of equal height an appearance reminiscent of *schlieren* photographs of gases. Approximate theoretical calculations can be carried out using the known analogy between two-dimensional gas flow and two-dimensional water flow in an open channel. The equations for the hydraulic problem are set out to exhibit the analogy, and the hydraulic case is further discussed. For ' small disturbances', for which the equation can be linearised, by supposing the water in a curved channel subjected to a sideways force U^2/R per unit mass (U = mean velocity, R = radius of curvature) it is found that the maximum increase of height at the outer wall is twice the statical increase. More exact calculations for the region between the beginning of the curvature and the section at which the first wave is reflected gave results rather over-estimating the observed effects found by experiment. The effect of skin-friction on the bottom of the channel is then introduced in the ' linearised ' equations, and an equation of the form of the ' telegraph ' equation results, so that damped oscillations of height are to be expected. The integration of the equation is discussed. S. G.

***1825. Efflux Phenomena Occurring at Sharp-Edged Orifices. D. Pavel.** *Bull. Math. et Physique*, 8. 1–3. *pp.* 158–167, 1936–1937. *In German.*—The efflux of water through orifices of various forms *viz.*, triangular, rectangular, star- and slit-shaped orifices is discussed theoretically and studied experimentally. Measurements are made of the coefficient of contraction, the resistance coefficient, the change of shape of the jet along its length, and the distribution of velocities in a cross-section of a jet. J. S. G. T.

See also Abstracts 1873, 2072, 2090, 2091, and
1550B. Thermoelectric Probe for Measuring Gas Velocity. A. Sellerio.

KINETIC THEORY OF MATTER.

1826. Molecular Potential Energy. P. Guareschi. *Accad. Lincei, Atti*, 26. *pp.* 398–402, *Dec.* 5, 1937.—The law of molecular attraction for liquids may be written in the form $f = \phi(q)$, where q is the molecular separation, $\phi(q) = -c/q^n$, and c is a universal constant. Introducing the molecular cohesion and the potential energy of a system of two molecules, expressions are derived for the frequency of vibration of the molecules. These involve the constant of molecular action (H), introduced in a previous paper, which is proportional to Planck's constant [see Abstracts 4043, 4044 (1936)]. These frequencies, calculated for several molecules in the solid state, are of the order of magnitude of the frequencies of atomic vibrations computed by the method of Planck, Einstein and Nernst. Applying the results to the critical point, where the molecular separation should be equal to the mean free path, it is shown that this is true to a close approximation for a number of substances. [See following Abstract]. C. J. B. C.

1827. Molecular Heats of Liquids. P. Guareschi. *Accad. Lincei, Atti*, 26. *pp.* 403–405, *Dec.* 5, 1937.—The methods of the previous paper [see preceding Abstract] are applied to the calculation of the molecular heats of a number of liquids, the values being in reasonable agreement with the experimental data. The atomic heats of some metals at their melting points are also computed. C. J. B. C.

1828. Effect of Polarised Light on the Brownian Movement. J. Kolb. *Phys. Zeits.* 39. *pp.* 194–197, *March* 1, 1938.—It is shown, by observations of the Brownian movement of Au particles of carefully determined size, that the effect of polarised light on the Brownian movement consists in a reduction (10 to 20% according to light intensity and particle size) in the directions of propagation and of the electric vector, with no change in the direction of the magnetic vector. The experimental method and interpretation of results are criticised by **A. Deubner,** *ibid. p.* 198, but defended by **R. Fürth,** *ibid. pp.* 198-199. C. B. A.

***1829. Velocity Measurements in the Brownian Movement of a Torsion Balance. E. Kappler.** *Ann. d. Physik*, 31. 5. *pp.* 377–397, *March*, 1938.—The theory of the method is given for a small torsion balance of moment of inertia $2 \cdot 35 \times 10^{-7}$ gm. cm^2., the motion of which, in a gas pressure of a few 1/100ths mm. Hg, was recorded on a film at a distance of 234 cm. From the records velocity determinations were made and it is shown that the velocity distribution is Gaussian. From the equation : $\frac{1}{2}m\bar{u}^2 = KT/2$, where m is moment of inertia, u angular velocity, and T absolute temperature, the value of K the Boltzmann constant is $1 \cdot 36 \times 10^{-16} \pm 3\%$ erg. degree^{-1}. The validity of the Maxwell-Boltzmann law of distribution is confirmed. The distribution of irregular impulses, J, communicated to the torsion balance in a given time is determined, and the proportionality of damping and square of the impulse, $\bar{J}^2$, which is assumed in the theory of the Brownian movement, is proved. [See also Abstract 330 (1932)]. G. E. A.

See also Abstract 1786.

MASS.

See Abstract 1829.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

1830. Whittaker's Solution of the Equation of Wave Motion. S. Syôno. *Phys. Math. Soc., Japan, Proc.* 20. *pp.* 100–104, *Feb.*, 1938. *In English.*—A relation is derived between two different forms of the solution of the wave equation. It involves the representation, by means of Bessel functions, of a superposition of plane waves of equal wave-length but varying direction. R. P.

1831. Hermite Polynomials. W. T. Howell. *Phil. Mag.* 25. *pp.* 600–601, *April*, 1938. [See also Abstract 1950 (1937).]

1832. Significance Tests when Several Degrees of Freedom Arise Simultaneously. H. Jeffreys. *Roy. Soc., Proc.* 165*A*. *pp.* 161–198, *April* 5, 1938.—Tests are provided for the significance of an estimated departure from a uniform distribution of chance, and of the coefficients of new functions introduced into an empirical law designed to represent a series of measures; in each case where several degrees of freedom may be expected to arise together if one of them does. A test is also given for the independence of errors of observation when the means of groups of consecutive observations are compared with the standard deviation of the entire set. Applications are made to the secular perturbations of the inner planets and to Pearson's data for errors of observation. AUTHOR.

See also Abstracts 2063, 2152, 2165.

MECHANICS, CLASSICAL.

1833. Kinematics of a Solid Body in Space of Three Dimensions. R. Woinarosky. *Accad. Lincei, Atti*, 26. *pp.* 263–266, *Nov.* 7, 1937. *In French.*—A mathematical paper in which the author finds the expression of the kinematic elements of the most general rigid motion as function of the geometrical elements of two regular surfaces. The method employed is the decomposition of the rigid motion to be studied into three elementary rigid motions. J. J. S.

MECHANICS, QUANTUM.

1834. Uncertainty Relations in the Measurement of Space-Time. R. W. Ditchburn and H. Motz. *Roy. Irish Acad., Proc.* 44*A*. *pp.* 45–76, *Dec.*, 1937.—The possibility, in principle, of measurements of the position of particles, and the time they require, is investigated. It is claimed that such measurements are not possible to the extent to which this is postulated in quantum mechanics. An attempt is made to apply the additional uncertainty relations in connection with the difficulties of nuclear physics. R. P.

1835. Dirac Matrix Systems of High Order. R. L. Gomez. *J. de Physique et le Radium*, 9. *pp.* 44–48, *Jan.*, 1938.—A general proof is given for the reduction to standard form of an arbitrary set of Dirac matrices. The result is applied to the neutrino theory of light. R. P.

1836. Construction of Zero-Order Wave Functions for Complex Atoms. B. Swirles. *Manchester Phil. Soc., Proc.* 82. *pp.* 21–28, *Jan.*, 1938.—A method given by Gray and Wills [see Abstract 3355 (1931)] for calculating the linear combinations of the one-body wave functions which serve as a starting-point for treating the interaction between the particles, is extended to the case of (j,j) coupling. R. P.

1837. Many-Body Problem in Wave Geometry. Part I. T. Hosokawa. *Hirosima Journ. Sci.* 8. *pp.* 29–41, *Feb.*, 1938. *In English.*—This paper develops the n-body problem, in which is considered n bodies in four-dimensional space, by the system of wave geometry through the introduction of $4n$-dimensional coordinate space V_{4n}, in which the coordinates of points are any ordered set of $4n$ independent real variables. V_{4n} is thus the coordinate space having the same system of coordinates as that of n bodies in four-dimensional space. The metric of space in V_{4n} is defined on the same principle by which $ds\,\psi$ in the fundamental equation is the metric of the space in four-dimensional space, and the initial considerations deal with matrices and tensors in 2^{ν} dimensions. N. M. B.

1838. Born's Electrodynamics in Terms of Wave Geometry. T. Iwatsuki, Y. Mimura, and K. Morinaga. *Hirosima Journ. Sci.* 8. *pp.* 43–50, *Feb.*, 1938. *In English.*—Unsatisfactory features of Born's development of the theory of the electromagnetic field are reviewed, and it is shown that wave geometry naturally implies Born's theory as a geometrised form and consequently the difficulties enumerated are overcome. [See Abstract 4856 (1937).] N. M. B.

1839. Wave Geometry Unifying Einstein's Law of Gravitation and Born's Theory of Electrodynamics. T. Sibata. *Hirosima Journ. Sci.* 8. *pp.* 51–79, *Feb.*, 1938. *In English.*—In view of the absence of any general principle for deciding on which wave geometry the geometrisation of physical pheonomena should be based, the justification of the geometry adopted must be judged on its results. A new line of enquiry is therefore developed, and, after the introductory theorems, a new form of fundamental equation for ψ, from a generalisation of wave geometry, is obtained in the form $\nabla_i\psi=\Lambda\gamma_i\phi$, the condition of complete integrability being $K_{ijkl} = (g/4)\epsilon_{ijpq}\epsilon_{klrs}K^{pqrs}$. It is shown that this condition is equivalent to Einstein's law of gravitation, and, as a special case, de Sitter space is deduced ; the fundamental equation for ψ in electromagnetic and material fields and its conditions of integrability are discussed, and it is shown that Born's theory of electrodynamics is implied in this wave geometry as a special case when a material field does not exist. N. M. B.

1840. Quaternion Theory. B. Kwal. *Comptes Rendus*, 206. *pp.* 642–644, *Feb.* 28, 1938.—It is shown in the theory of biquaternion functions how the generalised equations of Euler and Hamilton can be obtained by the use of certain operators and transformations. The general application to a space-time framework is indicated. G. O. B.

1841. Application of the Method of the Self-Consistent Field to Atomic Nuclei. M. Matricon. *Comptes Rendus*, 206. *pp.* 651–653, *Feb.* 28, 1938.—Wave functional considerations applied to a nucleus of n neutrons and p protons lead to the result that the normal energy between identical particles has the same form as the exchange energy of a Heisenberg force, and conversely. The same reciprocity exists between the energy due to a Majorana force and the energy due to a force with exchange of spin coordinate. N. M. B.

1842. Self-Consistent Field for Iron. M. F. Manning and L. Goldberg. *Phys. Rev.* 53. *pp.* 662–667, *April* 15, 1938.—This paper reports the results of self-consistent field calculations for the d^6s^2 configuration of iron. Preliminary calculations were made on the Massachusetts Institute of Technology differential analyser. The final results were obtained by numerical integration. For all of the wave functions the discrepancy between final and semi-final values of Z is less than 0·010. A brief discussion of the relation of the results to spectroscopy and to Slater's theory of ferromagnetism is given. AUTHORS.

1843. Quantum-Mechanical Significance of Silberstein's Theory. T. Neugebauer. *Ann. d. Physik,* 31. 6. *pp.* 540–550, *March,* 1938.—Silberstein's classical treatment of molecular polarisability [see Abstracts 425 and 772 (1917)] is compared with the quantum-mechanical treatment of this problem, the cause of marked discrepancy between results derived from the two theories being discussed in detail. J. S. G. T.

1844. Eddington's Treatment of Dirac's Equation. B. Podolsky. *Phys. Rev.* 53. *pp.* 591–595. *April* 1, 1938.—Eddington, in his book *Relativity Theory of Protons and Electrons,* makes statements to the effect that the invariance of Dirac's equation is an elementary consequence of the tensor form which it acquires in the new wave tensor calculus, in which it is merely an identity derivable on epistemological principles and not on physical hypothesis. It is shown in this article that the invariance of Dirac's equation referred to by Eddington is a purely formal one, while the invariance which is of particular interest in quantum mechanics depends upon the physical interpretation of the wave function. The generalisation of physical interpretation suggested by Eddington's work, however, has the desirable quality of leaving Dirac's equation invariant in the physical sense. It is further shown that in the derivation of Dirac's equation Eddington makes use of the usual physical assumptions, but in somewhat disguised form. AUTHOR.

See also Abstracts 1760, 1830, 1846, 2049, 2085, 2089, 2152, 2167.

PHILOSOPHY OF SCIENTIFIC METHOD.

1845. Philosophical Concepts in Modern Physics. E. U. Condon. *Frank. Inst., J.* 225. *pp.* 255–261, *March,* 1938.—The author investigates the question as to what is fair in theoretical physics. He defines as the object of physics " so to organise past experience and so to direct the acquisition of new experience that ultimately it will be possible to predict the outcome of any proposed experiment which is capable of being carried out—and to make the prediction in less time than it would take actually to carry out the proposed experiment". It is the task of the theoretical physicist to fit the relation of the data provided by the experimentalist into the body of knowledge previously known. Pure mathematics is the chief tool of the theoretician, and we have no right to restrict him to the use of only certain parts of mathematics. The first method to be used in theoretical physics was the infinitesimal calculus. It was followed by the introduction of the theory of probability into the interpretation of thermodynamical phenomena. Maxwell's theory of the electromagnetic field is another example for the fact that Newton's mechanics is not sufficient to explain all physical phenomena. But the new mathematical methods used in quantum mechanics, have caused the greatest revolution in physical thinking, the success of this method in giving a qualitative and very often quantitative interpretation of the known phenomena of atomic and nuclear structure has shown that Newtonian methods are outgrown. Condon concludes that from the point of view of his definition of the task of theoretical physics, the developments of quantum mechanics are satisfactory though he does not believe that it is ultimate in its present form. He thinks that possible future developments of theory will lie in the same direction as quantum mechanics. L. K.

1846. Operational Reasoning, Reality and Quantum Mechanics. E. C. Kemble. *Frank. Inst., J.* 225. *pp.* 263–275, *March*, 1938.—The paper discusses the philosophical foundations of quantum theory. It is denied that the notions (" constructs ") of quantum theory correspond very closely to any objective reality. The introduction of such an objective reality is not necessary for the purpose of a physical theory. The author believes that it must be possible, nevertheless, to give an objective meaning to the statement that an external world exists. R. P.

1847. "The Skeptical Physicist". P. R. Heyl. *Washington Acad. Sci., J.* 28. *pp.* 77–83, *March* 15, 1938.—The author reviews briefly Dingle's article on " Modern Aristotelianism " (*Nature*, 139. *pp.* 784–786, *May* 8, 1937) and contributions by Eddington and Milne to the ensuing discussion. The point of view of the author is indicated by the following remarks : (1) " The ability of a theory to calculate and predict phenomena is an asset of undoubted importance, but it is not enough, and must not be over-rated." (2) " When Minkowski points with pride to the mystic formula, 3×10^5 km. $= \sqrt{-1}$ sec., and when it requires no knowledge of tensors to see what the trouble is, the only conclusion possible is that the fundamental principles of mathematics and physics are like the laws of whist—for beginners to observe and for masters to disregard." (3) " The theory of relativity holds its own to-day only because no one has, as yet, been able to devise a better." The philosophical basis of Minkowski's theory is interestingly and briefly discussed. J. S. G. T.

1848. Impulsive and Conservative Causality in Nature. A. Mittasch. *Naturwiss.* 26. *pp.* 177–183, *March* 25, 1938.—The author discusses causality from two standpoints, which may be termed the impulsive (*Anstoss*) and the conservative (*Erhaltung*) points of view. The former, which controls catalytic and similar processes is illustrated by two stones dislodged from a height on a mountain and starting their respective avalanches ; there is not necessarily proportionality between the effects and the respective masses of the stones. The latter is illustrated by two stones thrown into the sea ; the effects are here proportional to the respective masses. Various other types of causality, *e.g.*, catalytic causality, total causality, stimulant causality, motive causality are introduced into the discussion. J. S. G. T.

PRESSURE.

***1849. Pendulum Micromanometer. R. Masek.** *Zeits. f. Instrumentenk.* 58. *pp.* 121–122, *March*, 1938.—Full details with illustrations are given of a portable micromanometer based on the pendulum principle. H. H. Ho.

See also Abstracts 1798, 1799, 1810, 2135, 2142.

RELATIVITY AND ETHER.

1850. Non-Statistical Solutions of the Gravitational Equations of Relativity. B. Datt. *Zeits. f. Physik*, 108. 5–6. *pp.* 314–321, 1938.—

The author considers a universe which contains discontinuous matter of variable density and which is symmetric with respect to the origin. The most general form of the line element in a system of moving coordinates is given by :

$$ds^2 = -e^{\lambda}dr^2 - e^{\mu}r^2(d\theta + \sin^2\theta d\phi^2) + e^{\nu}dt^2 + 2adrdt.$$

In this model the components of the gravitational acceleration of a free particle which is at rest with regard to θ, ϕ and r, are given by :

$$\frac{d^2r}{ds^2} = -\{44,\ 1\}\left(\frac{dt}{ds}\right)^2,\quad \frac{d^2\phi}{ds^2} = -\{44,\ 2\}\left(\frac{dt}{ds}\right)^2,\quad \frac{d^2\phi}{ds^2} = -\{44,\ 3\}\left(\frac{dt}{ds}\right)^2$$

$\{44,\ 1\} = \{44,\ 2\} = \{44,\ 3\} = 0$. It follows that v is a function of t only. The components of the Riemann-Christoffel tensors G_{11}, G_{22}, G_{33}, G_{44} and $G_{14} = G_{41}$ are the only components which do not vanish. The distribution of matter is found to be :

$-8\pi\,\delta_{00} = -2(3\psi + r\psi')/e^{\frac{3\mu}{2}}(r\mu' + 2)$, where $\mu' = d\mu/dr$ and ψ is an arbitrary function of r. Solutions for different distributions of matter are given. L. K.

1851. Invariant Form of the Maxwell-Lorentz Field Equations for Accelerated Systems. G. Kron. *J. of Applied Physics*, 9. *pp.* 196–208, *March*, 1938.—It is shown that the invariant field equations of Maxwell for stationary bodies are also valid for accelerated bodies, if all ordinary differentiations are replaced by absolute differentiation. The affine connection $\Gamma^{\gamma}_{\alpha\beta}$ appearing in the absolute derivatives refers to a general non-Riemannian metric space, with a holonomic or nonholonomic reference frame. The field equations are in a more general form than those used in the five-dimensional unified field theory and reduce to the latter as a special case. However, the presence of an electrostatic field is not assumed in this paper. The motion of an accelerated body possessing mass, electric current and magnetic flux is given by an extended form of the dynamical equations of Lagrange containing the same general affine connection as the field equations. The material terms of the dynamical equations are expressed by a mechanical impulse-energy tensor and the resultant motion of the material body under the influence of an electromagnetic field and a mechanical force is expressed by a combined impulse-energy equation. The equations are calculated for a representative rotating electrical machine used in industry. AUTHOR.

1852. Suggestion for Unifying Quantum Theory and Relativity. M. Born. *Roy. Soc.*, *Proc.* 165*A*. *pp.* 291–303, *April* 5, 1938.—The fact that the fundamental laws of quantum mechanics are symmetrical in space-time x^k and momentum-energy p_k can be generalised to a " principle of reciprocity " according to which the x-space and the p-space are subject to geometrical laws of the same structure, namely a Riemannian metric. In analogy with Einstein's closed x-world one has to assume that energetically closed systems (as elementary particles, nuclei) must be described by help of a hyperspherical p-space. A consequence of this assumption is a modification of the formula for the number of quantum states in an element of the p-space. The application of this formula to quantum electrodynamics leads to a finite zero energy of the vacuum, a finite self-energy of the electron, etc. Deviations from Planck's law and the Stephan-Boltzmann law of radiation, and the calorie properties of gases are predicted for very high temperatures. The application of this theory to nuclei leads to results confirming the assumptions. [See *Nature*, 141. *p.* 327, *Feb.* 19, 1938]. AUTHOR.

See also Abstracts 1834, 1838, 1839, 2178.

SOLUTION.

1853. Partial Molar Volumes of Strong Electrolytes at High Pressures. I. R. Kritschewsky. *Acta Physicochimica,* 8. 2. *pp.* 181–188, 1938. *In German.*—An equation for the pressure dependence of the partial molar volume of a strong electrolyte at infinite dilution has been derived thermodynamically, and is based on the simple formula already given by Born [see Abstract 171 (1921)] for calculation of the work of the electric forces during the passage of charged particles from one dielectric to another. This equation accounts for the increase of the partial molar volume of a strong electrolyte with pressure increase. The derived equation has been quantitatively confirmed by data of the partial molar volumes of NaCl and K_2SO_4 in their aqueous solutions at infinite dilution up to pressures of 3·000 bar. Quantitative data are given for solutions of NaI in methanol. H. H. Ho.

SURFACE PROPERTIES.

1854. Adsorption of Gases on Surfaces as a Particular Case of Dissociative Equilibrium. F. Cernuschi. *Comptes Rendus,* 206. *pp.* 585–587, *Feb.* 21, 1938.—Langmuir's adsorption isotherm in the form given by Fowler [see Abstract 2319 (1935)] is derived by a method which stresses the analogy with the law of mass-action. R. P.

1855. Orientation of Molecules in the Surface Layer of an Adsorbent and the Adsorption of Gases. Part II. B. A. Talmud and D. L. Talmud. *Acta Physicochimica,* 8. 2. *pp.* 171–180, 1938. *In English.*—New methods are described of preparing "inverted" adsorbents from palmitic acid [see also Abstract 954 (1937)]: (*a*) by automatic accumulation of unimolecular layers, (*b*) by skimming mixed unimolecular layers of palmitic acid and paraffin and (*c*) by precipitation of an aqueous solution of a palmitic acid salt by an aqueous solution of a mineral acid. The adsorptions of dry NH_3 and trimethylamine on the above adsorbents have been measured, and it was found that mixed films with medium concentrations of paraffin were exceptionally active as adsorbents. An explanation of the different activities of the various adsorbents is given. H. H. Ho.

1856. Adsorption of He on Charcoal below 78° K., and Production and Thermometry of Low Temperatures. E. Kanda. *Chem. Soc., Japan, Bull.* 13. *pp.* 241–246, *Jan.,* 1938. *In English.*—The adsorption of He on charcoal below 78° K. was measured and the heat of sorption was determined. Systematic trials of the desorption method for the purpose of obtaining low temperatures without liquid He are described. Resistance thermometers of manganin and of constantan were calibrated with the He gas thermometer down to 6° K. AUTHOR.

1857. Heat of Adsorption of He Gas near 1° K. J. W. Stout and W. F. Giauque. *Am. Chem. Soc., J.* 60. *pp.* 393–395, *Feb.,* 1938.—The adsorption of He gas on $NiSO_4, 7H_2O$ has been studied at the temperature of liquid He to obtain information relating to thermal equilibrium in calorimeters at these and lower temperatures. The heat of adsorption at 4·23° K. was found to be 131, 135, 137 and 148 cal./mol. for the equilibrium pressures $1 \cdot 12 \times 10^{-3}$, $7 \cdot 1 \times 10^{-4}$, $5 \cdot 8 \times 10^{-4}$, $1 \cdot 6 \times 10^{-4}$ respectively and it was estimated that the surface layers were 1 to 2 molecules deep. When a calorimeter is cooled from 4·23° to 1·35° K. true adsorption equilibrium is not obtained within the time usually required for various magnetic and calorimetric measurements. In such a case the He molecules

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adsorbed at the lower temperatures are held more nearly like those of liquid He. E. H. D.

1858. Adsorption of Vapours at Plane Surfaces of Mica. Part I. D. H. Bangham and S. Mosallam. *Roy. Soc., Proc.* 165*A*. *pp.* 552–568, *April* 27, 1938.—Measurements have been made of the quantities of benzene, CCl_4, and methyl alcohol adsorbed at a known surface area of mica at pressures ranging from 0·02 mm. to near saturation. The general shape of the benzene isotherm is sigmoid, convex to the adsorption axis at lower pressures, where the monolayer is incomplete, but becoming markedly convex to this axis near saturation, where the film is polymolecular. The same isothermal is obtained when the mica plates are separated by fine wires as when they are tightly packed together. Capillary condensation in incipient cleavages at the mica edges does not take place, and the polymolecular films have properties which differentiate them from the bulk liquids. The isothermals of benzene and methyl alcohol at lower pressures agree well with the theoretical equation for films of mobile molecules oriented end-on to the surface, but Langmuir's equation leads to limiting adsorption values which bear no relation to the lattice constants of the mica (muscovite). The isothermals of CCl_4 shows marked discontinuities, as also do those of benzene and methyl alcohol over the range of transition to polymolecular films. AUTHORS.

1859. Behaviour of Liquid Drops and Adsorbed Films at Cleavage Surfaces of Mica. D. H. Bangham and Z. Saweris. *Faraday Soc., Trans.* 34. *pp.* 554–570, *April*, 1938.—Organic liquids are found to be divided rather sharply into two classes, according to whether they do or do not spread on freshly split mica in air. The former group includes methyl and ethyl alcohols, formic and acetic acids, and acetone. In the absence of air and in the presence of their saturated vapours both classes behave alike, all the liquids examined—whether pure substances or mixtures—being found to have a finite contact angle when placed on vacuum-heated mica. The behaviour of liquid drops as regards spreading is considered to depend much on the structure and properties of the adsorbed film at the solid/gas interface. On mica the films formed by organic vapours are polymolecular except at low pressures, and by the use of supersaturated vapours they can be built up to Newton's colour thickness before nuclei of condensation for the bulk liquids appear. The effect of the surface is appreciable, therefore, not merely at molecular, but also at colloidal distances. Non-spreading liquids can generally be made to spread under the influence of the vapour of a suitably chosen second component, but the action is one-sided, for the contact angle of the second component is invariably increased by the vapour of the first. The well-known phenomenon of the pursuit of a liquid drop over a solid surface by a drop of a second liquid is connected with this one-sided behaviour of the mixed adsorbed film between the two. Liquid drops that are in the act of spreading have abnormal properties like those of the visible adsorbed films, and show abnormal relations in regard to miscibility. AUTHORS.

1860. Wetting of Pigments. E. Sauer and W. Gussmann. *Kolloid Zeits.* 82. *pp.* 253–269, *March*, 1938.—The speed of absorption of fluid by a powder can be regarded as a measure of its wetability. When the powder is loosely packed the grain shape and size considerably affect the speed and amount of absorption. Grain shape and size have little influence on the wetting speed of tightly packed powders, while the volume absorbed is roughly proportional to the interstitial volume. Hydrophilic powders wet quickly and require less water than hydrophobic powders, which wet more slowly. Methyl alcohol is absorbed by hydrophilic powders more quickly and to a greater extent than water. The relationship between the liquid absorbed by the compressed pigment and the oil requirements persists to the wetting-out point. P. H. B.

1861. Theory of Contact Angles. K. S. G. Doss and B. S. Rao. *Indian Acad. Sci., Proc. 7A. pp.* 113–117, *Feb.*, 1938.—A theory of contact angles is developed. The phenomena at the interface between a solid and a liquid are discussed on the basis of the theory. AUTHORS.

1862. Electron Diffraction Study of Passivity of Iron. T. Iimori. *Chem. Soc., Japan, Bull.* 13. *pp.* 152–158, *Jan.*, 1938. *In English.*—The transmissional electron diffraction pattern of the isolated film from passive iron and the reflectional one obtained from iron rendered passive in a chromate solution are in both cases either γ-Fe_2O_3 or Fe_3O_4. Collaborating with the author's previous work and consideration of the passivity of Fe_3O_4, the protective oxide film is believed to be γ-Fe_2O_3. AUTHOR.

1863. Surface Oxidation of Copper Single Crystals. T. Yamaguti. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 230–241, *March*, 1938. *In English.*—Electron diffractions from mineral cuprite and single crystals of Cu_2O, the latter being obtained by oxidising single crystals of Cu at high temperatures, were investigated. In the spot patterns, some spots corresponding to diffractions forbidden from the structure factor were observed, to which an interpretation was given. Orientations of the oxide single crystals to their mother Cu single crystals are determined by the analysis of the spot patterns from the crystals of both kinds, and three different relative orientations are observed, presence of which is to be attributed to presence of three different modes of transpositions, and is not due to recrystallisations, of Cu atoms in forming the Cu_2O lattice from the Cu lattice. Lattice constants of both Cu_2O formed under different conditions and mineral cuprite are determined from the spot patterns, knowing the wave-lengths of electrons from the diffraction rings of MgO powder, which was precipitated on the surfaces of the specimens. [See also Abstract 858 (1936).] AUTHOR.

1864. Electron-Optical Observation of Metal Surfaces. Parts III and IV. W. G. Burgers and J. J. A. P. van Amstel. *Physica*, 5. *pp.* 305–319, *April*, 1938. *In English.*—By means of the electron microscope it is shown that after passing the transition temperature the more or less equiaxed texture of cubic β-crystallites of Zr was replaced by a lamellar, hexagonal α-texture closely resembling the martensitic structure. On re-transformation the original β-crystallites reappeared and the process could be repeated. This behaviour is considered to confirm the conclusion that the transition is brought about by a homogeneous transformation by shearing and dilatation of coherent lattice regions from one crystalline state into the other, parallel to definite crystallographic directions ; the " sense " of the transformation being opposite in successive transformations. The occurrence of parallel lines of abnormal emissivity on a Ni-Fe kathode activated with Sr and Ba and subsequently given a further deposit of Sr and heated to 900° C. is investigated. Each line is composed of a number of spots, and since in most cases the lines run from crystal boundary to crystal boundary and reappear in practically the same directions if the kathode is deactivated by heating to a higher temperature and then reactivated, it is concluded that the directions of the lines are related to the orientation of the underlying crystal lattice. [For Parts I and II see Abstract 902 (1937).] A. G. Q.

1865. Transformation Temperature of a Metallic Film. Part II. T. Fukuroi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 767. *pp.* 333–343, *March*, 1938. *In English.*—Previous work [see Abstract 4302 (1937)] is now continued and changes of electric resistance and reflectivity of light with temperature rise have been measured for the cases of thin metallic films of Pb, Sb, Bi, Cd and Zn that had been deposited by evaporation on a cooled surface of pyrex glass previously baked out at 250°, 400° and 500° C. in high vacua. Metal films deposited on such a glass that had been thoroughly baked out and rendered free from adsorbed and occluded gases, did not exhibit any sharp decrease of resistance during the annealing process—a phenomenon associated with the so-called " transformation " (except the case of Sb). The reflectivity of light from the metal deposits was found to change with temperature rise almost in the same way as in the previous investigation (*loc. cit*), irrespective of bake-out of the substratum, *i.e.*, the reflectivity increased irreversibly as the resistance decreased. H. H. Ho.

1866. X-Ray and Optical Properties of Barium-Copper-Stearate Films. C. Holley. *Phys. Rev.* 53. *pp.* 534–537, *April* 1, 1938. —Barium-copper-stearate films, built by the successive deposition of layers one molecule thick, were used as diffraction crystals to obtain X-ray spectra. The measurements show that for these films the X-ray spacing has a constant value of approximately 50·47 Å for films with the same composition, with thicknesses varying from 301 to 3000 layers, but varies with the per cent of Cu in the film ; thin films produce as good spectra as do thick ones ; the reflecting planes are regular and definite ; the spacing is the same whether the molecules in adjacent layers are oriented in the same or in opposite directions ; and the unit decrement of the index of refraction is $5 \cdot 1 \times 10^{-6}$. From the total thickness of a film, as measured by a Michelson interferometer, the spacing of the molecular layers was found to be 24·23 Å. For the films in which the molecules in adjacent layers were oriented in opposite directions it was expected that the grating space would be twice the layer spacing, or 48·46 Å. The marked difference between this value and the X-ray spacing of 50·47 Å indicates that the X-ray spacing is not determined by the method of building the film.
AUTHOR.

***1867. Automatic Dipping Mechanism for Making Built-Up Films. R. W. Mattoon and S. Bernstein.** *Rev. Sci. Instruments,* 9. *pp.* 125–126, *April,* 1938.—A motor-driven dipping mechanism is described which has been used to make built-up *Y* films of 1000 molecular layers or more of barium-copper stearate, using the Langmuir-Blodgett technique. A rotating cam, the surface of which is determined by the equation $\rho = a\theta$, imparts a reciprocating constant linear velocity to a dipping rod holding the slide on which the film is deposited. The mechanism is counterbalanced. Available adjustments are the velocity of dipping, the length of stroke and the choice of end points, the reversal of the velocity at any time, and the orientation of the slide about a vertical axis. AUTHORS.

1868. Molecular Forces in Friction and Boundary Lubrication. N. K. Adam. *Inst. Mech. Eng., Proc.* (*Lubrication and Lubricants*), 2. *pp.* 197–201, 1937.—The main function of " boundary " lubricating films is probably to provide weak molecular links in the bridges formed between the submicroscopic elevations on the lubricated surfaces at the points where contact is close enough for the molecular attractions to operate between the surfaces. The constituent molecules of the films must adhere tightly to the surfaces and a reserve supply of film-forming material should be available. J. T.

1869. Adsorption of Oils in Relation to Lubrication. J. J. Trillat. *Inst. Mech. Eng., Proc.* (*Lubrication and Lubricants*), 2. *pp.* 418–428, 1937.—From determinations of interfacial tension it is shown that certain molecules, normally present in, or added to lubricants, are selectively adsorbed by metals and other bodies. The mechanism of adsorption is considered and a delicate method is provided for defining the quality of an oil as regards its activity or oiliness. J. T.

1870. Oiliness in Relation to Viscosity. A. W. Burwell and J. A. Camelford. *Inst. Mech. Eng., Proc.* (*Lubrication and Lubricants*), 2. *pp.* 261–273, 1937.—Coefficients of friction of several lubricants under various conditions are measured and it is concluded that when a film of lubricant is actually at work the composition of the film is not identical with that of the oil mass. The characteristics of the lubricating film are determined by the relative attraction for the metals comprising the bearing of each component of the mixture comprising the lubricant. J. T.

1871. Problem of "Oiliness." S. Kyropoulos. *Inst. Mech. Eng., Proc.* (*Lubrication and Lubricants*), 2. *pp.* 346–353, 1937.—"Oiliness" phenomena are due to molecular interactions and must be treated fundamentally as problems of molecular structure, molecular forces and crystallography. The viscosity drop owing to flow orientation and the problems of adsorption are discussed from this point of view. J. T.

1872. Oiliness of Liquids. Part V. H. Akamatu. Part VI. T. Sasaki. *Chem. Soc., Japan., Bull.* 13. *pp.* 127–141, *Jan.*, 1938. *In English.*—In Part V the static boundary frictions were measured when some binary or ternary mixtures were placed on the glass surfaces. The results suggest that: (i) the friction is governed by the surfaces with adsorbed layer of lubricant, and (ii) the friction-reducing power depends upon the individual molecular constitution of the molecules which are adsorbed preferentially by the friction surface, rather than upon the stability of the film. Selective adsorption by the glass surface is investigated. In Part VI measurements are made of the kinetic friction coefficient. The method consists of the observation of the sliding velocity of a slider on an inclined surface lubricated with the liquid to be tested. Special apparatus has been constructed to measure the sliding velocity. It is confirmed that the kinetic friction coefficient is generally independent of the velocity over the range of the experiment (up to about 100 cm./sec.), and the following equation holds: $\tan\theta - \{(\sqrt{2S_2} - \sqrt{2S_1})/g\}v^2 \sec.\theta = \mu_k$, where v is the mean velocity of the slider on the surface of the inclination θ. The above equation lacks the viscosity term, so the conditions of the boundary lubrication are considered to be satisfied. The kinetic friction coefficients of glycerin, aliphatic hydrocarbons, aliphatic alcohols, acetic acid, and water have been measured. [See Abstract 2451 (1937).] AUTHOR.

See also Abstracts 1778, 1821, 1873, 1997, 2073, 2074.

TIME.

See Abstract 2189.

VISCOSITY AND FRICTION.

1873. Free Discharge of Liquids from Capillary Tubes. A. Grumbach. *J. de Physique et le Radium*, 9. *pp.* 49–51, *Feb.*, 1938.

The author has established and integrated the equation for the variable conditions in the discharge of a liquid flowing by its own weight in a straight narrow vertical tube; at present the recognised equation for the permanent state of the liquid is that of Stokes. By means of the new equation an idea of the mode of working of viscometers is given, and an explanation is afforded for the erroneous data afforded by apparatus furnished with reservoirs of defective capacity. H. H. Ho.

1874. Viscosity of Oils at High Temperatures. G. Barr. *Inst. Mech. Eng., Proc.* (*Lubrication and Lubricants*), 2. *pp.* 217–221, 1937.—A vapour-bath method is described and an empirical formula given for the determination of the relation between the viscosity and temperature of oils. J. T.

1875. Graphical Solutions of Viscosity Problems. J. Groff. *Inst. Mech. Eng., Proc.* (*Lubrication and Lubricants*), 2. *pp.* 317–324, 1937.—Describes a graphical method which represents clearly everything connected with viscosity as a function of temperature and enables most of the frequently occurring problems to be solved with an accuracy of ± 2%. J. T.

1876. Viscosity of Dilute Solutions of Strong Electrolytes. E. Asmus. *Zeits. f. Physik*, 108. 7–8, *pp.* 491–499, 1938.—The relative viscosity of very dilute aqueous solutions of $MgSO_4$, $CuSO_4$, and $ZnSO_4$ is determined as a function of molar concentration by the differential method of Cox and Wolfenden [see Abstract 3567 (1934)]. For $MgSO_4$ the results confirm the discrepancy observed between experiment and the theory of Falkenhagen. For the other two salts, however, excellent agreement with the theory is observed. L. A. W.

***1877. Viscosity of Slag Systems. J. R. Rait and R. Hay.** *Roy. Techn. Coll. Glasgow, J.* 4. *pp.* 252–275, *Jan.*, 1938.—An apparatus has been designed suitable for measuring the viscosities of fused silicates. Results are given for the binary system (lime-silica), and for the ternary system (lime-silica-alumina). AUTHORS.

1878. Viscosity of Helium Gas between 293° and 1·6° K. A. van Itterbeek and W. H. Keesom. *K. Onnes Lab., Leiden, Comm. No.* 252*a*, *Physica*, 5. *pp.* 257–269, *April*, 1938. *In English.*—Measurements of viscosity, η, of He were made by the oscillating disc method at various temperatures from 293° Abs. to 1·6°, and (at 20·38° and 4·27°) at various pressures (p) down to about 10^{-4} mm. Hg. Results agree generally with Uehling's calculations [see Abstract 5140 (1934)], save at the lowest pressures. At ordinary pressure η is independent of p, but at the lowest it decreases to vanish with $p=0$, the relation being $\eta_p = \eta_\infty\, p/a\eta_\infty + p)$, where $a \propto \sqrt{T}$ being 71·99 and 36 for T = 26·38° and 4·25° Abs. respectively. C. A. S.

1879. Constitution and Viscosity Association of High-Molecular Hydrocarbons. B. Yamaguchi. *Chem. Soc., Japan, Bull.* 13. *pp.* 61–77, *Jan.*, 1938. *In English.*—The viscosity of solutions of four oils in benzene was determined, and an empirical equation connecting the viscosity association [see Abstract 1889 (1934)] and the temperature coefficient of viscosity was derived. The viscosity association and temperature coefficient of viscosity of solutions of three polysterenes differing markedly in polymerisation were also determined. The same empirical relationship holds for these solutions as for the oils. The effect of constitution on the viscosity association of high-molecular hydrocarbons was examined, the effect of length of side chain, straight chain as compared with branched chain, ring structure, and olefinic linkages in the side chain being determined. A. J. M.

1880. Action of Magnetic Field on Viscosity of *p*-Azoxyanisol. W. N. Zwetkoff and G. M. Michailoff. *Acta Physicochimica*, 8. 1. *pp*. 77–94, 1938. *In German.*—If an anisotropic substance is placed in an electric field of moderately high frequency $(\nu = 10^3 \sim)$ a motion is produced in it which grows in intensity with increasing field strength. This motion is characterised by the appearance of dark threads which extend from one electrode to the other. These threads are visible not only in polarised but also in ordinary light. The cause of the phenomenon is perhaps to be found in the inhomogeneity produced in the liquid by the current. The orientation of the molecules in the electric field is less complete than in the magnetic field. The cause of the orientation of the axes parallel to the lines of force in fields of low intensity is probably to be sought in the anisotropy of the viscosity and of the conductivity. [See Abstract 3852 (1937).] By means of the capillary method, both in parallel and perpendicular magnetic fields, a great anisotropy of the viscosity of *p*-azoxyanisol was observed. The largest coefficient of viscosity corresponds with the direction of field perpendicular to the molecular axis, the smallest with that parallel to the axis. A magnetic field of definite tension directed crossways was able to exert a measurable action on the time of outflow only with small ranges of velocity of current, *i.e.*, if the action of the flow orientating the molecules is not too strong. The observed effect in the magnetic field depends on the temperature.

J. J. S.

1881. Internal Friction in Solids. Part IV. Relation between Cold Work and Internal Friction. C. Zener. *Phys. Rev.* 53. *pp*. 582–586, *April* 1, 1938.—Previous investigators have found that cold working of metals has a marked effect upon internal friction, increasing it, in certain cases, by a factor of more than ten. In the present paper it is assumed that the effect of cold work upon internal friction is due to the residual internal stresses which it produces. During vibration these residual stresses give rise to fluctuations in temperature, and thus to local heat currents, which are inevitably associated with a rise in entropy, *i.e.*, with internal friction. A formula is obtained for this internal friction in terms of the energy associated with the residual stresses, and the temperature variation of the modulus of rigidity. It gives the observed order of magnitude. According to the theory developed in this paper, the measurement of the internal friction of a cold worked specimen over a wide frequency range and for various types of vibration will give not only the mean square of the residual stresses, but also their preferred axes, if any, and the mean linear dimensions of their inhomogeneities. [For Part III see Abstract 505 (1938).] AUTHOR.

See also Abstract 1821.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1882. Measurement of Photographic Magnitudes with a Hartmann Microphotometer. H. Fischer.** *Zeits. f. Astrophysik*, 15. 2. *pp.* 108–114, 1938.—In Fessenkoff's modification of the Hartmann microphotometer for measuring focal images of stars, the photographic plate is put inside the focus of the microscope objective, its image then falling in the exit aperture of the eyepiece. The author points out that the results obtained with this form of the apparatus depend on the position of the observer's eye, that the two fields never properly coalesce, and that the measuring is very fatiguing. An alternative arrangement eliminating these defects is described. The analysing lamp sends a beam of light through a narrow stop, in which the stellar image is centred, on to a diffusing screen, whose brightness is then balanced in the ordinary way. A similar stop and diffusing screen are introduced into the comparison beam. Results of two measurements of a single plate give a numerical idea of the accuracy and reproducibility of magnitude estimations by this method. The probable errors are compared with those obtained with photoelectric and thermoelectric microphotometers. A. Hu.

***1883. New Double Refractive and its Application to Double Star Measures. P. Muller.** *Comptes Rendus*, 206. *pp.* 822–824, *March* 14, 1938.—The double refractives suitable for the author's purpose are: (1) those having prisms with axes, one in the plane of the chief section, and inclined at any angle to the face of entry, the other normal to this plane (such as in Rochon's or Wollaston's); or (2) those having prisms with the axes in the plane of the principal section, making with the face of entry and exit any acute angles ϕ and ϕ'; indeed having $\phi = \phi'$. He describes two of their interesting properties. [**Erratum,** *ibid. p.* 1152, *April* 4, 1938.] [See Abstract 1003 (1938).] A. S. D. M.

COMETS AND METEORS.

1884. Comets. A. C. D. Crommelin. *Roy. Astron. Soc., M.N.* 98. *pp.* 347–350, *Feb.*, 1938.—Progress Report of the Council to the 118th Annual General Meeting.

1885. Interpretation of the Variable Structures of Cyanogen in Cometary Spectra. K. Wurm. *Zeits. f. Astrophysik*, 15. 2. *pp.* 115–123, 1938.—It is shown from the CN bands that on approach of a comet to the sun the structures of individual bands in comet spectra exhibit small but quite noticeable changes. With decreasing distance from the sun the maximum of intensity within a branch is displaced towards higher rotation quantum numbers. This displacement is produced by radiation absorption processes and may be regarded as a further proof that the luminosity of comet gases is a fluorescent phenomenon excited by the continuous solar radiation. At extremely small distances from the sun similar changes are to be expected for the vibration states. J. E. K.

1886. CH Bands and the Presence of Hydrogen in Comets. M. Nicolet. *Zeits. f. Astrophysik*, 15. 2. *pp.* 154–159, 1938.—It is discussed whether the band 4314 Å found in several comets can be ascribed to the CH molecule. It is shown that conditions in comets correspond to an effective temperature of approximately 300° K. The intensity ratios in the branches of the $^2\Delta \rightarrow {}^2\Pi$ band (4300 Å) of CH are theoretically calculated for this temperature, and a comparison is given between the wavelengths and intensities of the 4300 Å band of CH as observed in the laboratory, and the corresponding values found in comets. It is concluded that actually CH causes these bands in comets. L. K.

1887. Presence of the First Positive Group of Nitrogen in the Spectrum of Comet Finsler (1937, f). J. Gauzit. *Comptes Rendus*, 206. *pp*. 492–494, *Feb*. 14, 1938.—The author has succeeded in identifying the heads of a number of bands belonging to the system of the first N_2 group in the spectrum of Comet Finsler, no certain evidence of such radiations in cometary spectra having been produced before. The transition is $B^3\Pi \rightarrow A^3\Sigma$. The author attributes this group to the u.v. solar radiation throwing the N_2 molecules into the metastable state $A^3\Sigma$ in which they could remain for long periods owing to the low pressure. A slight further excitation could then raise the molecules to $B^3\Pi$. G. C. McV.

COSMOGONY.

1888. Expanding Universe. H. Shapley. *Nat. Acad. Sci., Proc.* 24. *pp*. 148–154, *March*, 1938.—An analysis of the result of a count of spiral nebulæ down to apparent photographic magnitude 18·2 in the south galactic polar cap is given. The number of nebulæ per square degree, N_m, in terms of apparent photographic magnitude m is found to satisfy $\log N_m = 0\cdot6(m - 15\cdot19)$. The material for the eastern and the western parts of the cap is compared and shows some irregularities. When used with Hubble's counts, the present one shows that the correction to m for red-shift lies between $3\cdot48\ d\lambda/\lambda$ and $1\cdot81\ d\lambda/\lambda$. It is concluded that no grounds exist for questioning the interpretation of red-shift as being due to velocity, given the present-day observational material. G. C. McV.

1889. New Basis for Cosmology. P. A. M. Dirac. *Roy. Soc., Proc.* 165*A*. *pp*. 199–208, *April* 5, 1938.—It is proposed that all the very large dimensionless numbers which can be constructed from the important natural constants of cosmology and atomic theory are connected by simple mathematical relations involving coefficients of the order of magnitude unity. The main consequences of this assumption are investigated and it is found that a satisfactory theory of cosmology can be built up from it. AUTHOR.

See also Abstract 1892.

NEBULÆ.

1890. Extra-Galactic Nebulae. J. H. Reynolds. *Roy. Astron. Soc., M.N.* 98. *pp*. 334–345, *Feb.*, 1938.—Progress Report of the Council to the 118th Annual General Meeting.

1891. Theory of Spiral Structure in the Nebulæ. B. Lindblad. *Zeits. f. Astrophysik*, 15. 2. *pp*. 124–136, 1938. *In English*.—A theory of the formation of spiral structure in nebulæ is developed, in adherence to principles given in earlier papers. The theory starts from the asymptotic orbits at the edge of a flattened distribution of mass. The tidal effects of ejected matter and the formation of heavy arms by successive dissection of the original central system by these effects are discussed. It is shown that a system with fully developed spiral structure may have an approximately uniform angular speed of rotation. The normal appearance of two opposite symmetrical arms and an approximately logarithmic form of the arms are consequences of the theory. AUTHOR.

1892. Apparent Luminosity of Receding Nebulæ. M. v. Laue. *Zeits. f. Astrophysik*, 15. 2. *pp.* 160–161, 1938.—The paper is a contribution to the discussion [see also Abstract 1028 (1938)] whether in an expanding universe every body takes part in the expansion. If the three components T_4^k ($k = 1, 2, 3$) of the density tensor are zero, it follows that all matter which is enclosed in a surface $F(x_1, x_2, x_3) = O$), which is fixed in space remains there for all time, *i.e.*, takes part in the expansion. It is shown that it can be concluded mathematically from Einstein's field equations that $T_4^k = O$. But the objection can be made that the g_{ik} are not valid in and near matter as they are averages for large spaces, so that matter does not take part in the expansion. This is the idea which forms the basis of all cosmological discussions. L. K.

See also Abstract 1888.

PLANETS.

1893. Liquefaction of the Terrestrial Globe. A. Mercier. *Arch. des Sciences*, 20. *pp.* 31–58, *Jan.–Feb.*, 1938.—The terrestrial globe is assumed to have been initially a polytropic gas sphere of average molecular weight 32, of radius about 10^{10} cm. and with central temperature 6000° C. The distribution of density, pressure and temperature in such a globe leads to the conclusion that metallic vapours will condense in the outer regions of the sphere. G. C. McV.

1894. Minor Planets. A. C. D. Crommelin. *Roy. Astron. Soc., M.N.* 98. *pp.* 346–347, *Feb.*, 1938.—Progress Report of the Council to the 118th Annual General Meeting.

See also Abstract 1832.

STARS.

1895. Red Magnitudes in Standard Regions at + 15°. C. Payne-Gaposchkin. *Harvard Coll. Obs., Ann.* 89. 8. *pp.* 123–142, 1937.—Photo-red magnitudes have been determined for the brighter stars in the twelve Harvard Standard Regions at + 15°. The magnitudes have been obtained from plates taken with the 12-in. Metcalf refractor at Cambridge, and the 24-in. Bruce refractor at Bloemfontein. Eastman I-C Special plates, with the Ciné Red filter, have been used. The magnitudes have been established by Polar comparison with one of the Harvard Standard Regions, and by referring the other eleven to this one, either directly or indirectly. Care has been used to avoid systematic error in carrying the system of standards round the sky. Standardisations with objective gratings, though not used directly to establish the scale, furnish a check upon the results, and show that if any scale error exists in the final magnitudes it is not large. The spectra of the standard stars have been reclassified by Miss Cannon. AUTHOR.

1896. Standards for Selected Areas 140-206. S. Gaposchkin. *Harvard Coll. Obs., Ann.* 89. 9. *pp.* 143–169, 1937.

1897. Magnitudes of 30 Brightest Stars in the North Polar Sequence. J. Stebbins and A. E. Whitford. *Mt. Wilson Observat., Contrib. No.* 586. *Astrophys. J.* 87. *pp.* 237–256, *April*, 1938.—The magnitudes and colours of stars of the North Polar Sequence down to magnitude 11·6 have been measured with a photo-cell attached to the 60-in. reflector. The measured colours of these stars are in good agreement with the colours of the international system, and confirm the result of Seares that the polar region is one of moderate obscuration and selective absorption. Special treatment is given to the known variable Polaris ; the phase and amplitude of the light variation of this star agree well with the prediction from recent photoelectric measures by Meyer. The photoelectric magnitudes have the usual small accidental errors, and the scale has been tested over the range from magnitude 2·5 to 11·6. Laboratory measures of an artificial star, observations of stars with a neutral-shade glass, observations of the stars down to magnitude 9·2 with the 15-in. telescope at Madison, and independent measures of 13 stars with an ultra-violet cell on the 60-in., all agree in giving the same scale of magnitudes. There are serious differences between the photoelectric and the international photographic magnitudes, especially from the fifth to the ninth magnitude, where the two systems diverge by nearly 0·20 mag. The possibility that this divergence is due to strong hydrogen absorption is discussed by Seares [see following Abstract]. Formulæ are given for the reduction of photoelectric or photographic magnitudes to our suggested revision of the international scale. AUTHORS.

1898. Photoelectric Magnitudes and the International Standards. F. H. Seares. *Mt. Wilson Observat., Contrib. No.* 587. *Astrophys. J.* 87. *pp.* 257–279, *April,* 1938.—When international colour indices are used with a linear formula for the reduction, a comparison of the photoelectric measures by Stebbins and Whitford [see preceding Abstract] of the North Polar Sequence with standard photographic magnitudes shows satisfactory agreement in scale for the interval 6·5–11·6, including the 24 stars 2s–16. The average difference is ± 0·017. To obtain an independent set of differences for a photovisual comparison, photoelectric colours must be used, giving an average of ± 0·030 mag. A scale divergence for stars 1–5, which reaches a maximum of 0·13 mag. and cannot be explained wholly by errors in either the photoelectric measures or the standards, possibly represents the influence of hydrogen absorption on the photographic standards. The photoelectric magnitudes are not appreciably affected by this absorption. Owing to the short spectral interval covered by the photoelectric measures of colour, the colour indices C_2 are not directly comparable with the standard colour indices C_I. For the polar region the values of C_2, reduced to the scale of C_I, show an excess dispersion of ± 0·033 mag. not accounted for by observational error. Systematic differences are also present. This lack of comparability is attributed to departures from black-body radiation, originating, possibly, in the star and certainly to some extent in the absorbing cloud known to affect the light of some of the polar stars. The relatively large average difference found from the photovisual comparison arises from the excess dispersion in C_2. Revised photographic and photovisual magnitudes and colour indices are given for the 30 brightest stars of the Polar Sequence. The revision includes data accumulated since the *Rome Report* of 1922 was prepared. The international scales and colour system remain unchanged ; only the accidental errors are affected. AUTHOR.

1899. Comparison of Leiden and Mount Wilson Magnitudes for Polar Stars. F. H. Seares. *Mt. Wilson Observat., Contrib. No.* 588. *Astrophys. J.* 87. *pp.* 280–283, *April,* 1938.—A comparison of recent Mount Wilson magnitudes for bright stars in the polar region with photographic and photo-visual results by de Sitter shows excellent agreement. With the exception of a scale difference of 0·03 mag. for Pg magnitudes between 7·25 and 7·75 and a zero-point difference of the same amount for

Pv data (of low weight) south of 83°0′, the accordance is complete. The average difference for a star, based on all Pg results and on the Pv magnitudes north of 83°0′, is ± 0·03 mag. Owing to difficulties met in reducing the Mount Wilson measures to the international system, the result of the comparison is important. AUTHOR.

1900. Investigation of Standards of Magnitude with a Wedge Photometer. A. H. Farnsworth. *Astrophys. J.* 87. *pp.* 352–360, *April*, 1938.—A condensed account is given of extensive work by Parkhurst using a wedge photometer on telescopes of aperture 6, 12 and 40 inches for the measurement of 435 stars in groups, at 7, 9, 12 and 15 mag. The scale of the 6-in. reflector between 7^{m} and $9^{m}.5$ is similar to that of *Harvard Annals*, 45 and 74. Between $9^{m}.5$ and 12^{m} the ratio of the interval as given by *Harvard Annals*, 74, to that of the 12-in. refractor is 1·38, indicating marked scale divergence. Three more recent investigations of a portion of the fields: remeasurement with the photometer on the 12-in., photovisual determinations with a grating on the 24-in. reflector, and photovisual polar comparisons with the 12-in. Metcalf telescope at Harvard Observatory, concur in reducing the divergence by 41, 67 and 90% respectively (the last is of relatively low weight). Tentatively a scale 1·25 times that of the early wedge on the 12-in. is suggested as being near the truth. AUTHOR.

1901. Isophot and Effective Wave-Lengths in the Photometry of Integral Brightnesses, Isoplene and Effective Absolute Brightness in Stellar Statistics. A. Brill. *Zeits. f. Astrophysik*, 15. 2. *pp.* 137–142, 1938.—A clear distinction is not always made in the literature between the isophot and the effective wave-lengths and between the isoplene and the effective absolute brightnesses. The object of this paper is to stress the necessity for distinguishing between these magnitudes and to this end the equations by which they are defined are formulated and discussed in detail. J. E. K.

1902. Mass-Luminosity Law and Parallaxes of Eclipsing Binaries. G. Durand. *Comptes Rendus*, 206. *pp.* 490–492, *Feb.* 14, 1938.—The mass-luminosity law of Eddington together with a knowledge of the relative masses and luminosities as well as of the maximum value of the apparent magnitude of an eclipsing binary may be used to determine the parallax of the double star. Applied to 22 binaries in Moore's Catalogue, the method gives fairly consistent results. G. C. McV.

1903. Relation Between Red and Yellow Colour Indices in Harvard Standard Region C4. J. L. Greenstein. *Harvard Coll. Obs., Bull. No.* 907. *pp.* 30–36, *Jan.* 1, 1938.—Galactic latitude + 11° and longitude 169°, in Gemini is free from strong nearby interstellar cloud absorption. The relation between red and yellow indices is almost linear. (A table and diagram are given). No significant departure from linearity is found even among the very red stars. The material suggests the conversion of red into yellow indices by a simple formula. The red system scale is 1·39 the yellow; its zero is such that zero yellow corresponds to − 0·025 red index. A0 stars give mean colour index − 0·27 ± 0·05. The dependence of mean colour index on apparent magnitude for all types later than F8 is striking; the fainter late type stars are bluer if measured by either their red or yellow indices. If absolute magnitude were responsible then stars of G0 type (or later) brighter than red 9 would be giants; those fainter than 10 dwarfs. But other evidence excludes this explanation. A. S. D. M.

1904. Spectrophotometric Investigations of δ Cephei Stars. Part IV. (S. Sagittae). W. Strohmeier. *Zeits. f. Astrophysik*, 15. 2. *pp.* 85–96, 1938.—The monochromatic brightness differences of the cepheid variable S Sagitta relative to the comparison star 11 Sagitta (BD 16°4081) are obtained from 37 panchromatic films taken with a mirror prism camera. The differences are represented by a red and a blue gradient intersecting at 470 ± 16 mμ, the amplitudes of the gradient fluctuations being 0·81 and 1·32 respectively. Three light curves (557, 478, 410 mμ) are derived having amplitudes $0^{m}75$, $1^{m}01$ and $1^{m}51$ as well as the observed colour index curve with amplitude $0^{m}76$ and the reduced absorptionless colour index curve with amplitude $0^{m}56$. The minima of the gradient curves occur $0^{d}20$ later and the minimum of the colour index curve $0^{d}10$ later than those of the light curves. In conclusion relations are set up between the spectral type, relative gradient and brightness for both increasing and decreasing branches of the light curve and it is shown that the gradient differences for the same spectral type are large in comparison with those for the same brightness. [For Part III see Abstract 5256 (1937).]
J. E. K.

1905. Absorption of Light in Space. S. Rosseland. *Roy. Astron. Soc., M.N.* 98. *pp.* 301–310, *Feb.*, 1938.—Progress Report of the Council to the 118th Annual General Meeting.

1906. Line Profiles. R. O. Redman. *Roy. Astron. Soc., M.N.* 98. *pp.* 311–333, *Feb.*, 1938.—Progress Report of the Council to the 118th Annual General Meeting.

1907. Dissociation of Molecules in the Carbon Stars. Y. Fujita. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 149–159, *Feb.*, 1938. *In English.*—Formulæ are derived for the electron pressure and surface gravity of carbon stars as a function of luminosity, mass and temperature. By carbon stars are meant stars in the atmosphere of which C atoms are relatively more abundant than in ordinary stars; they are R and N giant types of high, intermediate and low luminosity. From the formulæ the abundance of various types of molecule is calculated and the results for CN and C_2 are used to explain the variations in intensity with spectral type of the CN and Swan bands observed by Shane. J. E. K.

1908. Neutrons and White Dwarfs. M. C. Johnson. *Observatory*, 61. *pp.* 74–83, *March*, 1938.—The evidence underlying Kothari's conclusions [see Abstract 5260 (1937)] on the H content of white dwarfs is analysed. The relevant observational facts are summarised and the large zero-point energy of a white dwarf, considered as a highly degenerate gas, is assigned to free electrons which may combine with protons to give neutrons. The conditions needed for such neutron synthesis are however unknown, the process never having been observed experimentally, and it is emphasised that any assumption that complete loss of H occurs in white dwarfs of more than a certain critical mass is premature. Kothari's theory is shown to affect very differently the "opacity" theory of Eddington which is applied to the relative abundance of elements in a stellar perfect gas, and on the other hand the work of Milne, Chandrasekhar, and others, in which a star's history is decided by collapse on to a degenerate gas core.
A. Hu.

1909. Nuclear Energy Sources and Stellar Evolution. G. Gamow. *Phys. Rev.* 53. *pp.* 595–604, *April* 1, 1938.—The behaviour of a star with a thermonuclear energy source consistent with our present knowledge about nuclear reactions is studied in relation to the problems of stellar evolution and interpretation of the Hertzsprung-Russell diagram and mass-luminosity relation. It is found that in the case of ordinary thermonuclear reactions, with the absence of selective temperature effects (nuclear resonance) the central temperature and luminosity of the star (with constant mass) will rapidly increase in the process of evolution. If, however, such selective effects are present, the energy-production at the centre of the star will cease, beginning with the stage when the central temperature reaches the selective value, and energy will be produced only in a spherical shell around the centre. This shell will have exactly the selective temperature value corresponding to the thermonuclear reaction in question, and its radius will slowly increase in the process of evolution causing a very slow increase of luminosity. Finally, in the third stage of evolution, when all hydrogen necessary for thermonuclear reactions has been consumed, the star will start a rapid contraction and, passing through the high density stage, will end its life as a cool body. It is also indicated that the star model with a shell source does not possess the property of "super-stability" characteristic for the point-source models. AUTHOR.

1910. Relation of Electron Gas Pressure to Radiation Pressure in Degeneracy and Non-Degeneracy. D. S. Kothari and B. N. Singh. *Zeits. f. Astrophysik,* 15. 2. *pp.* 143–153, 1938. *In English.*—The relation between gas pressure and radiation pressure is discussed in detail. It is shown that for degeneracy the gas pressure must be larger than the radiation pressure, though a gas pressure large compared with radiation pressure does not necessarily imply degeneracy. For non-degeneracy there is no restriction on the ratio of gas to radiation pressure, though a gas pressure small compared with radiation pressure necessarily implies non-degeneracy. AUTHORS.

1911. Theory of Pressure-Ionisation and its Applications. D. S. Kothari. *Roy. Soc., Proc.* 165*A. pp.* 486–500, *April* 27, 1938.—The main results which have been obtained from the application of the theory of pressure-ionisation may be summarised as follows: (i) The theory predicts that the stellar material in the interior of the white dwarf stars should be fully ionised. (ii) It predicts the existence of a maximum radius for a cold body. The value of this maximum radius is about the same as the radius of the planet Jupiter. There cannot be a "cold" body (planet or white dwarf) larger in size than Jupiter. (iii) The theory shows that the two heaviest planets (Jupiter and Saturn) have cores composed of metallic hydrogen. The terrestrial planets have cores of much heavier metal, possibly iron. AUTHOR.

1912. Distribution of 89000 Galaxies over the South Galactic Cap. H. Shapley. *Harvard Coll. Obs., Circ. No.* 423 [11 *pp.*], 1937.—The south galactic polar cap has been selected for concentrated study of the distribution of galaxies and of stars because of its apparent freedom from non-uniform space absorption and from pronounced clusterings of galaxies. A survey is here given of the total number of galaxies to the magnitude limit 18·2, as a preliminary to the detailed study of all the new galaxies that can be photographed with the Bruce telescope in three-hour exposures. Nearly 90,000 new objects have been found on 80 plates. The density of galaxies varies greatly over the polar cap, the richest field (nine square degrees) being ten times as populous as the poorest. The mean number per square degree, reduced to the common magnitude limit 18·2, is 51·5, a value somewhat less than that found by Mount

Wilson and Harvard observers for the high latitude sky in general. In the mean the density decreases from galactic latitude — 55° to the south galactic pole, but the major part of the decrease occurs in one quadrant only. The value of the basic constant m_1 in the hypothesis of uniform space density varies from 15·0 to 15·5 in the four quadrants and is in the mean 15·19, agreeing approximately with Mount Wilson and Lick Observatory results. Further studies of the south galactic cap are in progress: the stellar distribution to the 15th magnitude; the classification, measurement, and distribution of individual galaxies brighter than the 15th magnitude; the systematic photometry of all the fainter objects. AUTHOR.

1913. Globular Cluster Messier 92. J. J. Nassau. *Astrophys. J.* 87. *pp.* 361–366, *April*, 1937.—The distance modulus of Messier 92 is determined from the bright stars and the mean magnitude of 12 cluster-type variables. From the former, $m - M = 14·93$; and from the latter, 14·94 ± 0·01. Two variables not belonging to the cluster are indicated, as well as two other stars with range in variation of 0·25 mag., which are marked as probable variables. From star counts, the ratio of the minor to the major axis is found to be 0·85, with a position angle of of the major axis of 28°. Sensitometer tracings give 14′ for the diameter of the cluster. AUTHOR.

1914. Spectrographic Studies of Nova Lacertae 1936. W. E. Harper, J. A. Pearce, C. S. Beals, R. M. Petrie, A. McKellar. *Dominion Astrophys. Obs. Victoria, Publ.* 6. 20. *pp.* 317–364, 1937.—Compared with the Novæ Herculis (1934) and Aquilæ (1918) lines are few. Of velocities of expanding shells, III was the highest ever measured for a nova (about 3700 km./sec.). Velocity accelerations, and absorption are compared with Nova Aquilæ (1918), and favour the idea of three distinct and separate explosions, together with ejections of isolated jets. Interstellar K-line with distance-velocity curve gives a distance of 830 parsecs, and an absolute magnitude at maximum of — 7·5. Stellar Na lines (like interstellar Na) are definitely, stronger than Ca lines. At maximum light the temperature was 6650° increasing to 34000° by August 4. The nucleus at maximum was 210 ⊙, but shrank by early August to 2·9 ⊙, with density 1/28 ⊙. A. S. D. M.

1915. Early Stages of Nova Herculis. Part II. Bright Line Spectra. F. L. Whipple and C. Payne-Gaposchkin. *Harvard Coll. Obs., Circ. No.* 414. [13 *pp.*], 1937.—The authors compare their results with those of Greaves-Martin and of Williams. They disagree with Grotrian's finding that the April fall in brightness was due to the continuous spectrum [see Abstract 2470 (1937)]. For intensities of bright lines, they find (*a*) both permitted and forbidden increase as regards the continuous spectrum intensity; (*b*) forbidden lines increase as regards permitted where the excitation levels are roughly comparable; (*c*) for both, the intensities of higher excitation increase with regard to lower; (*d*) the colour temperature of the Nova rises. They also find that the rate of continuous ejection of material from the central star varies directly with the bolometric luminosity; thus a luminosity fall produces a temperature rise and effective height of photosphere decreases, so that thermodynamic equilibrium deviation becomes more pronounced and continuous emission weakens as regards bright line emission. [For Part I see Abstract 4074 (1936).] A. S. D. M.

1916. Double Stars. W. H. van den Bos. *Roy. Astron. Soc., M.N.* 98. *pp.* 353–355, *Feb.*, 1938.—Progress Report of the Council to the 118th Annual General Meeting.

1917. System of Algol. W. J. Luyten. *Zeits. f. Astrophysik,* 15. 2. *pp.* 97–107, 1938. *In English.*—The fluctuations in the time of light minimum of δ Algol to be expected theoretically are discussed, taking into account apsidal motion and nodal regression in the close pair as due to perturbations by the third body. It is shown that a previous formula derived by Lyttleton [see Abstract 621 (1935)] is seriously in error and a nodal regression determined by Shayn [*Astrophys. J.* 57. *p.* 129, 1923] invalid. AUTHOR.

1918. Eclipsing Star WZ Ophiuchi. S. Gaposchkin. *Harvard. Coll. Obs., Bull. No.* 907. *pp.* 1–5, *Jan.* 1, 1938.—Leiner gave $2^{d}\cdot091748$ for the period, and eclipse duration about 5 hr.; amplitude 1/2 magnitude. Both components are G0, and all data suggest a pair of dwarfs that can be compared directly with the sun, unlike other—and elliptical—G eclipsing dwarfs. Tables and diagrams are given of visual minima, light curves and elements of the orbit, but the period (according to Sanford's recent observations) must be doubled. The absolute dimensions are those of a pair, slightly smaller and denser than the sun. The WZ OPH system is the first case, from complete data, known to be non-elliptical dwarfs. A. S. D. M.

1919. Photoelectric Observations of Eclipsing Binary 44i Bootis B, H. Shapley and W. A. Calder. *Harvard Coll. Obs., Bull. No.* 907. *pp.* 13–20, *Jan.* 1, 1938.—The variability of the fainter component of 44i Bootis B and Σ 1909 = ADS 9494, was discovered by Schilt on Mt. Wilson photographs. Two elliptical solar type stars are involved in the eclipsing binary; they are probably nearly equal in dimensions and surface luminosity and are almost in contact. The true amplitude at primary minimum of $0^{m}\cdot6$ (*qp*) is reduced to $0^{m}\cdot16$ through the inclusion in the measures of the brighter component. The orbits in both the visual and eclipsing binary systems are highly inclined to the tangent plane. A. S. D. M.

1920. Spectroscopic Multiples, 52 and 58 Persei. R. Tremblot. *Comptes Rendus,* 206. *pp.* 740–742, *March* 7, 1938.—The author observed, from 1934–38, at the Haute-Provence Station of the Paris Observatory these multiple stars. 58 Persei resembles type cG_2, except that the H and K calcium bands are replaced by fine and strongly contrasted lines, indicating the superposition of two stars of which the fainter (type A_0) has a continuous background too feeble to modify the metallic lines of the primary. Its complete study would take 20 years. 52 Persei is of type $G_0 + A_5$, and resembles 58, except that the H and K lines indicate that orbit as of short period; on two plates taken 5 days apart, they appear first double, and then large and diffuse. The colour indices, 1·34 and 1·00, respectively, surpass those of giant stars of the same type, and this is probably due to selective absorption in space. A. S. D. M.

1921. Secondary Variation of δ Scuti. T. E. Sterne. *Astrophys. J.* 87. *pp.* 133–150, *March,* 1938.—From photoelectric measures of δ Scuti, Fath has suggested a superposed period of $5^{d}\cdot24774$, due to interference between the fundamental period of $0^{d}\cdot19377$ and one slightly larger or smaller than this. Such can be interpreted in terms of the pulsation theory, but for such a close pair, the author finds the suggested periods are spurious. The radial velocity may contain a periodic secondary variation having the same period (not yet known) as the secondary variation has in magnitude, and which therefore cannot be due to the comparison star. He suggests that short period Cepheid ephemerides may (and commonly do) have " sine terms " arising from secondary variations with periods other than the fundamental (or its submultiples). He treats of the stars' physical conditions: radius ($3{\cdot}6 \odot$); mass ($2{\cdot}5 \odot$); $\bar{\rho}$ ($0{\cdot}076$ gm./cm^3.); G from $T\sqrt{G\bar{\rho}/6\pi} = 0{\cdot}274$. He concludes that the fundamental variation may be the lowest radial mode of an Eddington model with the adopted mean density and a reasonable value of γ (about 1·54). [See Abstract 3953 (1937).] A. S. D. M.

1922. Catalogue of 1113 Galaxies in a Region in Fornax and Eridanus. R. H. Baker. *Harvard Coll. Astron. Obs., Ann.* 88. 6. *pp.* 165–176, 1937.

SUN.

1923. Rotation Velocity of Solar Prominences. L. and (Mme.) d'Azambuja. *Comptes Rendus,* 206. *pp.* 819–822, *March* 14, 1938.—Prominences and spots alone are stable enough to give position measures on (at least) two successive apparitions, and it is only by spectroscopic methods that the dark prominence filaments are seen on the solar disc. The authors have extended a study begun at Meudon in 1923, to include the whole 11-year cycle, 1919–1930. They have found for this the formula $\xi = 14^\circ{\cdot}46 - 1^\circ{\cdot}94 \sin^2\phi$ holding between solar latitudes 0° and 40°, and have also extended it to include 16 values between 40° and 70°. A. S. D. M.

1924. Solar Activity (Prominences). A. L. Narayan. *Roy. Astron. Soc., M.N.* 98. *pp.* 351–352, *Feb.*, 1938.—Progress Report of the Council to the 118th Annual General Meeting.

1925. Observations of Solar Corona and Protuberances from Pic du Midi, 1937. B. Lyot. *Comptes Rendus,* 206. *pp.* 648–650, *Feb.* 28, 1938.—Details are given of observations made May–July, 1937, over the range 3300–11000 Å from 125 spectra, 13 direct photographs of the corona and 60 m. of kinematograph film for changes of protuberances. Ten coronal rays were observed and a new one in the yellow-green at 5694·42 ± 0·07 Å. The movements of protuberances are described. [See Abstract 574 (1937.] R. S. R.

1926. Total Light and Colour of the Solar Corona of June 8, 1937. J. Stebbins and A. E. Whitford. *Astrophys. J.* 87. *pp.* 225–236, *April,* 1938.—The total light of the corona was measured with a photo-cell and portable amplifier at Cerro de Pasco, Peru, altitude 14,500 ft. The corona was referred to a set of standard lamps, which were later compared with the full moon. The atmospheric extinction for altitude 5°40′ at mid-totality was determined by measures of the sun on the same day before and after the eclipse. The ratio of corona to full moon was 0·47, in good agreement with determinations at previous eclipses. There is no evidence of a large variation of the light of the corona in different years. The colour of the corona was found to be the same as that of the sun. Since there is no Rayleigh scattering, the light must come either from electrons or from particles too large to produce such scattering. AUTHORS.

1927. Solar Activity (Sunspots). H. W. Newton. *Roy. Astron. Soc., M.N.* 98. *pp.* 350–351, *Feb.*, 1938.—Progress Report of the Council to the 118th Annual General Meeting.

See also Abstracts 1946, 2192.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

1928. Dielectric Constant of Metallic Suspensions and the Measurement of Ore Content. H. Löwy and M. M. Ghali. *Gerlands Beitr. z. Geophys.* 52. 3–4. *pp.* 334–343, 1938. *In English.*—Experiments were made concerning the relation between the dielectric constant of mixtures and their concentration of metal. A formula of Poincaré, and others deduced from Lorentz's theory, are discussed. " Electrodynamic volume " is defined and an introduction of this notion in the theory of Lorentz supplied. A formula is given to deduce the dielectric constant of rock material from that of rocks. R. S. R.

HYDROSPHERE, PHYSICS OF THE.

1929. Calculation of Absorption Coefficients of Daylight in Natural Waters. R. T. Young, Jr. *J.O.S.A.* 28. *pp.* 95–99, *April,* 1938.—The calculation of the true absorption coefficient of daylight in natural waters is discussed. It is shown that the vertical absorption coefficient K defined by $K = -1/I(dI/dz)$, where I is the intensity of light and z the vertical depth, is related to the true absorption coefficient k, defined by $k = -1/I(dI/dr)$, where r is the path length in the direction of the light, by the expression : $K = k\int_0^{2}\int_1^{\infty} J'(\vartheta, \phi)\frac{e^{-kzx}}{x}dxd\phi / \int_0^{2\pi}\int_1^{\infty} J'(\vartheta, \phi)\frac{e^{-kzx}}{x^2}dxd\phi$, where $J'(\vartheta, \phi)$ is the intensity per unit solid angle per unit area just below the surface, ϑ and ϕ are the angles of refraction and azimuth respectively, ρ is defined by $\rho = \sec\vartheta$, and a is a number which depends upon the total amount of light reflected at the surface and the index of refraction. The integrals are evaluated for the special case that $J'(\vartheta, \phi)$ is a constant, corresponding to the conditions prevailing on a perfectly cloudy day, and it is found that near the surface K must be increased around 20% of its measured value to give k. AUTHOR.

***1930. Submarine Photometer for Studying the Distribution of Daylight in the Sea. C. L. Utterback and P. M. Higgs.** *J.O.S.A.* 28. *pp.* 100–102, *April,* 1938.—This paper describes the construction of a photometer which is designed to measure narrow spectral bands of submarine daylight. The photometer is capable of making rather rapid and nearly simultaneous measurements of spectral bands of both transmitted and scattered light. The design permits operation from a boat which is not provided with special electrical equipment. AUTHORS.

LAND, PHYSICS OF THE.

1931. Continental Drift. P. Sconzo. *Accad. Lincei, Atti,* 26. *pp.* 453–459, *Dec.* 19, 1937.—On the assumption that the sublayer of the crust (the sima) increases in density downwards, the effect of the drift of a continent on the length of the sidereal day is considered. W. A. R.

1932. Wegener's Theory of Continental Drift. H. V. Gill. *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 124–130, 1937. *In English.*—The spin of a teetotum when balanced and unbalanced and the automatic adjustment from the latter to the former by movable masses are considered. These ideas are applied to the earth by assuming that Europe-Africa was anchored while America moved westward and Asia-Australia eastward to give balanced spin. During the earth's cooling rivers and oceans developed. These motions are now thought to have finished. Comparatively small temporary disturbances of the distribution of the earth's mass are quickly corrected as by earthquakes.

R. S. R.

See also Abstract **1928.**

METEOROLOGY.

1933. Auroral Spectrum of 25 January, 1938. J. Dufay and J. Gauzit. *Comptes Rendus*, 206. *pp.* 619–621, *Feb.* 21, 1938.—At Saint-Genis-Laval, this aurora was photographed by two spectrographs: (1) with a flint prism and 300mm. objective at F/6·8, (2) with two flint prisms and 25mm. objective at F/1. Agfa I.S.S. panchromatic plates hypersensitised for several hours in dilute NH_4OH were used. A Ne spectrum was imposed beside the auroral on each plate. The first (exposed towards the N.N.W.) from 21^h50^m to $23^h\ 50^m$ showed intense and well separated lines 6300 and 6363 Å of neutral O and some feeble bands in the red. The second spectrograph exposures were made in the same direction, but the second and third exposures were damaged by cloud and rain. A table is given of the auroral lines compared with those given by Vegard and with laboratory nitrogen.

A. S. D. M.

***1934. Blueness of Sky and U.V. Radiation. H. Landsberg and H. Jobbins.** *Gerlands Beitr. z. Geophys.* 52. 3–4. *pp.* 270–279, 1938. *In English.*—For the blueness of sky determinations over the visible sky a new instrument is described consisting of a blue glass wedge illuminated by reflected sunlight and movable across the eyepiece a linear relation results between these determinations and the blue scale estimates. A diurnal variation is found with a minimum at noon. For higher visibilities a deeper blue is found and a more rapid increase of blue shade from horizon to zenith. Simultaneous u.v. radiation measurements together with those in 1934–5 now properly corrected for temperature are discussed, together with variations with solar elevation and daytime. Earlier it was found that low, medium and deep sky blues were correlated with high, low and higher u.v. radiation values. Now however increasing values of blue steps and u.v. radiation are coincident.

R. S. R.

1935. Seasonal Variations in Daylight. W. R. G. Atkins. *Roy. Soc., Proc.* 165*A*. *pp.* 453–465, *April* 27, 1938.—A Burt vacuum Na photocell was used with a Cambridge " thread recorder " to obtain daily records of the vertical illumination, around 0·41μ. The greatest, least and mean values of the daily maximum are tabulated for each month, as are the corresponding measurements of the illumination integral in kilolux-hours. The constancy of the cell was established, and it was shown that the daily maxima varied from 3·2 to 197·6 kl. on the C arc K cell scale, which for average daylight is close to the mean noon sunlight Se cell scale. The monthly mean of daily maxima was 150·9 for July, 1930 and 12·4 for Dec., 1931. From April, 1930 to Feb., 1931 the monthly means were, all save Dec., maximal for the 8 years. The daily illumination integral varied from 14·5 to 1323 kl.hr., and the monthly means from 45·6 in Dec., 1934 to 781 in July, 1930; in this year the means for April, June, July, Aug., Sept., Oct., Dec., also Jan., 1931 were maxima for the 8 years. Five years averaged 309 kl.hr. a day, but 1930 showed 414, whereas 1933 had the highest sunshine average.

No satisfactory explanation of the high values of 1930 is forthcoming, but Nov., 1937 exceeded the high Nov., 1930. The vertical radiation integral, as measured at London, showed that 1930 was rather higher than other years. Possibly the explanation lies in the persistence of exceptionally clear upper air during 1930, or perhaps in an actual increase in the ratio of u.v. to green in the solar spectrum as found by Pettit, a result contested by Bernheimer. The six summer months receive from 3/4 to 4/5 of the annual daylight; of this the brightest month (May, June or July) receives 15–18% and Dec. 1·5%. AUTHOR.

***1936. Radio Meteorograph. H. Diamond, W. S. Hinman, Jr. and F. W. Dunmore.** *Bureau of Standards, J. of Research,* 20. *pp.* 369–392, *March,* 1938.—Experimental work conducted for the U.S. Navy Department on the development of a radio meteorograph for sending down from unmanned balloons information on upper-air pressures, temperatures, and humidities, has led to radio methods applicable to the study of a large class of upper-air phenomena. The miniature transmitter sent aloft on the small balloon employs an ultra high-frequency oscillator and a modulating oscillator; the frequency of the latter is controlled by resistors connected in its grid circuit. These may be ordinary resistors mechanically varied by instruments responding to the phenomena being investigated, or special devices the electrical resistances of which vary with the phenomena. The modulation frequency is thus a measure of the phenomenon studied. Several phenomena may be measured successively, the corresponding resistors being switched into circuit in sequence by an air-pressure-driven switching unit. This unit also serves for indicating the balloon altitude. At the ground receiving station, a graphic frequency recorder, connected in the receiving set output, provides an automatic chart of the variation of the phenomena with altitude. The availability of a modulated carrier wave during the complete ascent allows to tracking the balloon for determining its azimuthal direction and distance from the receiving station—data required in measuring the direction and velocity of winds in the upper air. AUTHORS.

1937. Advances in International Meteorology in 1936 and 1937. W. R. Gregg. *Monthly Weather Rev.* 65. *pp.* 385–387, *Nov.,* 1937.—A summary of the conferences held in the period is given. These arose out of the action taken by the International Meteorological Organisation at Warsaw in 1935, resulting in the appointment of Regional Commissions for different parts of the world. Attention is drawn to the resolutions adopted by the International Meteorological Committee at Salzburg. These deal with the introduction of radio meteorographs, the protection of flights on international routes, the adoption by all countries of the international code, the formulation of a uniform code for transmission of forecasts, etc. Resolutions were also adopted dealing with agricultural meteorology, climatology, synoptic weather. A Sub-Commission on sea swells has decided to institute a week of observation of swells in North Atlantic in 1938. A. E. M. G.

See also Abstracts 1939, 2077, 2094.

SEISMOLOGY.

1938. "High Focus" Earthquakes of the International Seismological Summary. E. Tillotson. *Gerlands Beitr. z. Geophys.* 52. 3–4. *pp.* 377–407, 1938. *In English.*—The 20 earthquakes listed as "high focus " shocks by the International Seismological Summary have all been investigated individually and the results tabulated. It appears that in the majority of cases where the S residuals are very large, the multiple shock hypothesis is the one which can be upheld with most justification. In the best observed of these shocks practically all the stations read the P of the first shock, in which case it is an easy matter to determine the epicentre with the assistance of a good table for P waves. Should the first shock or shocks be feeble and emergent some stations miss the first P and read the second or third, and in this case the determination of the epicentre is more difficult. Having obtained the epicentre, the S residuals then sort themselves out into groups according to the initial times of the shocks, and it is possible to pick out misindentified pulses, which are reflected and refracted waves. The test of the hypothesis is then to look at as many seismograms as possible and find all the P and S onsets for all the separate shocks. If they are all present where calculations indicate they should be, then the hypothesis is probably correct. A difficult set of seismograms to interpret fully would be those from two shocks separated in time by 20 sec. and having a distance between the epicentres of approximately 2°. The author has not come across a well observed earthquake of this type. AUTHOR.

1939. Atmospheric Pressure Variations as Secondary Cause of Earthquakes. V. Conrad. *Union Géodésique et Géophysique Internationale Travaux Scientifiques, No.* 15. *pp.* 118–123, 1937.—For each epicentral region a choice of meteorological stations was made to obtain pressure changes prior to the earthquake and these changes were subdivided into combinations with rising, falling or almost constant pressure. Examination shows that some foci react to intense pressure changes apparently because of geological structure but others do not react at all. It is not possible to regard quite generally that pressure changes are secondary causes of earthquakes. R. S. R.

***1940. New Type of Vertical Seismograph. O. Somville.** *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 137–145, 1937.—The apparatus is of the Ewing type and the arm between the axis of rotation and the pendulum is bent as in the Wilip modification thereof, but downwards instead of upwards. It is, however, partly supported by the spiral springs, and partly by a system of articulated rods, the whole being adjustable. Diagrams and methods of adjustment are given in detail, and several examples of seismograms obtained with the machine. C. A. S.

***1941. Electromagnetic Seismographs. J. Coulomb and G. Grenet.** *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 146–150, 1937.—The theory of these instruments [see Abstract 661 (1935)] is briefly recapitulated, and examples are given of seismograms obtained therewith corresponding, under various arrangements, with a sinusoidal wave starting suddenly, the amplification being 1000-fold. C. A. S.

***1942. Piezoelectric Quartz Seismograph. E. Rothé.** *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 152–164, 1937.—After a sketch of the piezoelectric properties of quartz and the method of measurement thereof, their application to a seismograph is described in some detail, with specimens of the seismograms obtained with such an instrument, the shocks measured resulting from various artificially produced disturbances. C. A. S.

*1943. **Simple Torsion Pendulum as an Accelerogram Analyser. F. Neumann.** *Union Géodésique et Géophysique Internationale, Travaux Scientifiques, No.* 15. *pp.* 208–216, 1937. *In English.*—The method described makes it possible to determine quickly the motion of any other type of pendulum from the record of an accelerograph. A general description is given of the function of the torsion pendulum as an analyser. The set-up of the apparatus and the theory of it are supplied. With the torsion pendulum analyser some of the more difficult problems are avoided particularly with regard to the zero position. R. S. R.

See also Abstract 2013.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1944. Space Charge in the Atmosphere. Part II. C. W. Lutz. *Gerlands Beitr. z. Geophys.* 52. 3–4. *pp.* 344–376, 1938.—The apparatus described earlier [see Abstract 3228 (1934)] has given records over four years of space charge according to W. Thomson's procedure and simultaneously the potential gradient was measured with a Benndorf electrometer. The results are tabulated. Both space charge and potential gradient throughout the year are predominantly positive. On undisturbed days a close connection exists between them for small oscillations and for diurnal and annual changes. It is concluded that potential gradient is primarily determined by the charge in the surface layers, as theory indicates. The diurnal and annual changes are described. Weather influences both in the same direction and large disturbances such as thunder quickly alter the regular oscillation. For comparison the observations at other places are used and an explanation is given of some differences. Finally former results of other workers are described. R. S. R.

1945. Regular Progressive Changes of the Magnetic Field of Diurnal Variations of Terrestrial Magnetism. Part II. M. Hasegawa and Y. Tamura. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 4–8, *Jan.*, 1938. *In English.*—An examination of earlier observed data shows that the average diurnal variation of terrestrial magnetism consists mainly of two parts (1) variation of magnetic force due to rotation of a magnetic field around the earth, and (2) the contribution from regular changes of this rotating magnetic field with universal time. The latter is made up of zonal and rotating components and the former is more prevalent and definite. Mathematical expressions of earlier results are given and discussed. The zonal components are the principal part of the solar diurnal variation of terrestrial magnetism. [See Abstract 583 (1938).] R. S. R.

1946. Physical Causes of Earth's Magnetism. H. Haalck. *Gerlands Beitr. z. Geophys.* 52. 3–4. *pp.* 243–269, 1938.—It is considered that under the conditions of high temperature and pressure the earth's interior is ionised and the resulting electrostatic forces are discussed. Pressure in the interior causes a separation of charges with positive excess at the centre and negative in the outer parts. Convection currents arise with the earth's rotation and the normal rotational-symmetrical geomagnetic field results. Relations between the separation of charges and magnetic moment of the earth are obtained. Applying these to the sun, the solar magnetic field obtained agrees with Hale's observations. During the cooling of the earth a secondary field resulted in the crust with a higher degree of magnetisation in continental masses but irregularities occurred due to differences of composition and temperature. Local and regional anomalies are thus explained. Secular variation is a regional phenomenon with probably changes of magnetisation due to temperature variations at 10–50 km. depth as the cause. R. S. R.

See also Abstracts 1984, 1985, 1986, 2190, 2193.

RADIOACTIVITY.

1947. Radioactivity of Potassium. A. Bramley and A. K. Brewer. *Phys. Rev.* 53. *pp.* 502–505, *April* 1, 1938.—The radioactivity of K was measured with a Geiger counter by placing a thick layer of the salt under a thin Al window. The results agree with those of Mühlhoff and give the radioactive constants when corrected for the relative abundance of K_{40} the following values: $\lambda = (1 \cdot 56 \pm 0 \cdot 6) \times 10^{-17}$ sec.$^{-1}$, and $T = (14 \cdot 2 \pm 3 \cdot 0) \times 10^{+8}$ yr. AUTHORS.

1948. Radon Content of Tap-Water. G. J. Sizoo and C. P. Koene. *Physica,* 5. *pp.* 215–219, *April,* 1938. *In English.*—The Rn content of 15 samples of tap-water from various waterworks in the Netherlands was measured. The lowest values (about $0 \cdot 07$—$0 \cdot 09 \times 10^{-10}$ C./l.) were found for the waterworks drawing their water from the dunes along the coast of the North Sea. The highest value ($1 \cdot 50 \cdot 10^{-10}$ C./l.) was shown by the water drawn from the sandy region in the centre of the country, the Veluwe. The method of measuring is briefly described. AUTHORS.

1949. Uranium Z and Nuclear Isomerism. N. Feather and E. Bretscher. *Roy. Soc., Proc.* 165*A*. *pp.* 530–551, *April* 27, 1938.—The radiations from uranium Z have been examined by the absorption method using a tube counter. The effective quantum energy of the γ-radiation is $0 \cdot 70 \pm 0 \cdot 05 \times 10^6$ eV and the intensity $1 \cdot 50 \pm 0 \cdot 25$ quanta per disintegration. An analysis of the β-radiation into continuous spectra with limiting energies $0 \cdot 56$ and $1 \cdot 55 \times 10^6$ eV, and intensities in the ratio 17 : 1, is suggested, though it is pointed out that the component of lower energy is probably itself complex. The uranium X_2-uranium Z branching ratio has been determined as 665 ± 65 : 1. On the basis of these results the isomerism of the nuclei UX_2 and UZ is discussed in the light of v. Weizsäcker's hypothesis and a level scheme is put forward which appears to account for all the facts. Reasons are given in support of the conclusion that uranium Z is formed from uranium X_2 in a β-γ branching, rather than from uranium X_1, directly in a β-β transformation. AUTHORS.

1950. Radioactivity Induced in the Rare Earth Elements by Fast Neutrons. M. L. Pool and L. L. Quill. *Phys. Rev.* 53. *pp.* 437–446, *March* 15, 1938.—With the exception of Il, Tm and Lu all the rare earth elements have been bombarded with slow and fast neutrons. The fast neutrons were obtained from the Li + D reaction. Deuterons of $6 \cdot 3$ eMV were produced by the cyclotron at the University of Michigan. The following periods for electron emission have been observed: La^{140} (31 hr.), Pr^{142} (19 hr.), Nd^{147} (84 hr.), Nd^{149} ($2 \cdot 0$ hr.), Nd^{151} (21 min.), Il^{144} ($12 \cdot 5$ hr.), Sm^{151} (21 min.), Sm^{153} (46 hr.), Eu^{152} ($9 \cdot 2$ hr.), Tb^{160} ($3 \cdot 3$ hr.), Dy^{165} ($2 \cdot 5$ hr.), Ho^{164} (47 min.), Ho^{166} (30 hr.) Er^{169} (12 hr.), and Er^{171} ($5 \cdot 1$ hr.). The following periods for positron emission have been observed: Ce^{139} ($2 \cdot 1$ min.), Pr^{140} ($3 \cdot 5$ min.), Eu^{150} (27 hr.), Tb^{158} ($3 \cdot 6$ min.), Dy^{159} ($2 \cdot 2$ min.) and Er^{165} ($1 \cdot 1$ min.). There seem to be at least two isotopes which are isomeric: one is Gd^{159} ($3 \cdot 5$ min., 17 hr.) and the other is Yb^{175} ($2 \cdot 1$ hr., 14 hr.). From radioactivity data it is necessary to postulate the existence of four new stable isotopes: Gd^{152}, Dy^{160}, Er^{164} and Yb^{170}.

With the fast neutron bombardment seventeen *n*-2*n* type of reactions have been found. AUTHORS.

1951. Proton Induced Radioactivities. L. A. DuBridge, S. W. Barnes, J. H. Buck and C. V. Strain. *Phys. Rev.* 53. *pp.* 447–453, *March* 15, 1938.—Results are tabulated of the radioactivities produced by 4 eMV protons in targets of $_{7}N$, $_{8}O$, $_{20}Ca$, $_{24}Cr$, $_{27}Co$, $_{30}Zn$, $_{34}Se$, $_{42}Mo$, $_{46}Pd$, $_{48}Cd$, $_{49}In$. In most cases the reactions are of the *p*-*n* type, and lead to isotopes which emit either + or − electrons. A detailed study was made of O, Zn and Se. The reaction $O^{18}(p,n)F^{18}$ (107 min.) shows a threshold at 2·56 eMV and a positron energy of 0·74 eMV in good agreement with the energy relations. The cross-section for the reaction at 4 eMV is about 2×10^{-25} cm². and there is a resonance maximum at 3·55 eMV. The cross-section for the reaction $O^{16}(p,\gamma)F^{17}$ is 4000 times smaller. The isomeric Br^{80} periods (17·4 min, and 4·45 hr.) are observed in the reaction $Se^{80}(p,n)Br^{80}$. At 4 eMV the ratio of the short to long period activities for infinite bombardment is about 15 but the thresholds are at about 3·0 and 3·2 eMV, respectively. The cross-section for the reaction is about $0{\cdot}6 \times 10^{-26}$ cm². at 4 eMV. AUTHORS.

1952. Energy of Protons Emitted in the Transmutation of Boron by α-Particles. F. Joliot and I. Zlotowski. *Comptes Rendus*, 206. *pp.* 750–752, *March* 7, 1938.—The transmutation $^{10}_{5}B + ^{4}_{2}He \rightarrow ^{13}_{6}C + ^{1}_{1}H + Q$ was investigated by bombarding a target of B with α-particles from Po (64 mc.). The energies of the resulting protons were deduced from the curvature of their paths in a magnetic field of 16000 gauss. There were observed groups of energies 7·5–9 eMV ($Q = 4{\cdot}3$), and 6·5–5·5 ($Q = 2$), none of 7·5–6·5, and no negative protons. It is hence concluded that the group with $Q = 3{\cdot}1$ eMV does not exist, but is replaced by the two groups with $Q = 4{\cdot}3$ and $2{\cdot}0 \pm 0{\cdot}2$. [See Abstract 143 (1938).] C. A. S.

1953. Radioactivity Induced by Neutrons in Ruthenium. H. de Vries and J. Veldkamp. *Physica*, 5. *pp.* 249–256, *April*, 1938. *In English.*—Ru, containing probably about 0·03% of Rh, was bombarded with slow neutrons yielding (denoting a radioactive element of period *t* by R_t) $R_{45 sec.}$ and $R_{4 min.}$, certainly due to the Rh and also $R_{4 hr.}$, $R_{20 hr.}$ and $R_{45 day}$. The $R_{39 hr.}$ found by Livingston, instead of the author's $R_{20 hr.}$, is probably due to his bombardment having been with deuterons. It was then bombarded with fast neutrons which gave besides $R_{45 sec.}$ and $R_{4 min.}$ due to Rh, $R^{20}{}_{min.}$ and $R^{4}{}_{hr.}$ It is concluded that $R_{4 hr}$, $R_{20 hr.}$ and $R^{45}{}_{day}$ are due respectively to Ru^{103}, Ru^{105} and Rh^{105}, the last giving a chain reaction. Nothing certain can be stated about $R_{20 min.}$ It is further shown that the intensity ratio of two simple exponentials into which the decay curve can be separated, if $\lambda_1 > \lambda_2$, have an extrapolated intensity ratio $(\lambda_1 - 2\lambda_2) : \lambda_2$. C. A. S.

1954. Identification and Measurement of Helium Formed in Beryllium by γ-Rays. E. Glückauf and F. A. Paneth. *Roy. Soc., Proc.* 165*A*. *pp.* 229–238, *April* 5, 1938.—While it has been known for some time that the Be nucleus, irradiated by γ-rays, emits neutrons, it could not be decided whether the nucleus is thereby transformed into a stable isotope of Be of mass 8, or into two He atoms. By a micro-chemical method He was detected in Be after irradiation by the γ-rays of Rn. In one of the experiments the number of neutrons simultaneously emitted during the irradiation was determined by measuring the He produced by these neutrons in methyl borate; a comparison of the two He quantities showed that the main final product of the γ-irradiation of Be is He and not the Be isotope. [See following Abstract.] AUTHORS.

1955. Occurrence of Helium in Beryls. J. W. J. Fay, E. Glückauf and F. A. Paneth. *Roy. Soc., Proc.* 165*A. pp.* 238–246, *April* 5, 1938.—Various specimens of old Be metal have been analysed for He. Since the very sensitive method used failed to detect any traces of He it must be concluded that the spontaneous production of He in Be is less than $1 \cdot 3 \times 10^{-11}$ c.c. of He/gm. Be/year. From this figure it follows that the He content of beryls cannot be explained as a consequence of the spontaneous disintegration of a Be isotope of mass 8. Even the assumption that such a Be isotope was present in previous geological periods and has now mostly decayed is not compatible with the very low limit found for present-day He production. In recent years the He content of beryls has been attributed to the influence of γ-rays from radioactive minerals in the neighbourhood of the beryls, and to cosmic radiation. From the figures, however, given in the preceding paper [see preceding Abstract] about the amount of He produced in Be by γ-rays it follows that the influence of the natural sources of γ-radiation is not nearly sufficient to explain the He content of beryls. Since, therefore, Be does not produce adequate amounts of He, either under the influence of external radiation or as a consequence of spontaneous disintegration, it seems that the He content of beryls is not connected with its Be content at all, but is due to some other chemical element. AUTHORS.

1956. Disintegration of the Deuteron by α-Particles. H. L. Schultz. *Phys. Rev.* 53. *pp.* 622–628, *April* 15, 1938.—The non-capture disintegration of the deuteron by fast α-particles has been observed. Neutrons emitted in the transmutation were detected with the aid of a BF_3 filled ionisation chamber surrounded by paraffin and connected to a high gain amplifier thyratron recording system. Both Ra C′ and Th C′ α-particles were used to bombard a gaseous target of D_2. Essentially " thin layer " technique was employed in obtaining cross-sections for the disintegration process by comparing the neutron yields from D_2 and N_2 under identical conditions. Mean cross-sections of $0 \cdot 12 \times 10^{-26}$ cm². and $0 \cdot 30 \times 10^{-26}$ cm². were obtained for the range intervals 5·7 to 6·9 cm. and 7·4 to 8·6 cm., respectively. These experimental values are lower than theoretical estimates obtained from computations made by Massey and Mohr who used an approximation method. AUTHOR.

1957. γ-Radiation from Boron Bombarded by Protons. W. A. Fowler, E. R. Gaerttner and C. C. Lauritsen. *Phys. Rev.* 53. *pp.* 628–636, *April* 15, 1938.—Employing a Wilson cloud chamber the authors have determined the distribution in energy of pairs and recoil electrons ejected from Pb and C laminæ by the γ-radiation from B bombarded by protons. Both the pair and electron distributions indicate three prominent γ-ray components at $4 \cdot 3 \pm 0 \cdot 3$ eMV, $11 \cdot 8 \pm 0 \cdot 5$ eMV, and $16 \cdot 6 \pm 0 \cdot 6$ eMV with relative intensities of 1 : 1 : 1/7, respectively. The radiation is believed to result from proton capture by B^{11} to form an excited state of C^{12} which radiates in a single transition to the ground state or in a double transition through the well-known intermediate state at 4·3 eMV. Resonance in the yield has been found only in the region 150 → 200 kV and the total yield of quanta per incident proton above resonance on a thick B target is estimated to be $\geq 5 \times 10^{-10}$. [See following Abstract.] AUTHORS.

1958. Boron Plus Proton Reactions. J. R. Oppenheimer and R. Serber. *Phys. Rev.* **53.** *pp.* **636–638,** *April* 15, **1938.**—A discussion of the experimental evidence on the $B^{11} + H^1$ reactions and of the selection rules available for their interpretations shows that it is not possible to obtain a satisfactory description on the assumption that the same resonance level of C^{12} is responsible, both for the 16 eMV γ-ray observed by Fowler, Gaerttner and Lauritsen [see preceding Abstract], and the long range α-particles whose angular distribution was determined by Neuert. AUTHORS.

1959. Emission of α-Particles. J. Brenet and H. Armand. *J. de Physique et le Radium,* **9.** *pp.* **73–80,** *Feb.,* **1938.**—Two series of automatic recordings of Po α-particles are analysed from the point of view of the distribution of the largest intervals between emissions, which are taken in groups of *n* consecutive intervals from a total of N_0 recorded intervals. The two recordings contain 7000 and 14000 intervals respectively. The resolving powers are 1/1000 sec. and 1/350 sec. respectively. The accuracy obtained is 0·8% in the first case and 2·5% in the second, at the mean intervals. This accuracy is considered satisfactory. The legitimacy, of applying to the group, corrections accruing from the number of intervals not recorded is discussed; it is decided that it is preferable to reduce the importance of this correction. The agreement between the theory of greatest values and the observations on the intervals between α-particle emissions appears to be satisfactory. An interpretation arising from the results is discussed. G. O. B.

1960. Effect of Electric Fields on the Decomposition of Ammonia by α-Rays. C. Smith and H. Essex. *J. Chem. Phys.* **6.** *pp.* **188–196,** *April,* **1938.**—The following values have been obtained for the ion yields in the α-ray decomposition of gaseous NH_3 in the absence and presence of electric fields at 30° C. and 100° C.

30° C.	no field	1·37	100°C.	no field	2·42
	half-saturation	1·17		half-saturation	2·06
	full saturation	1·08		full saturation	2·01

The results are interpreted upon the hypothesis that in a field sufficiently strong to produce half-saturation, the ions are neutralised upon the plates without decomposition. If this hypothesis is correct, of the ion yield 1·37 at 30° C., 0·40 is the ion yield due to recombination of ions and 0·97 the ion yield due to other mechanisms. Similarly of the ion yield 2·42 at 100° C., 0·72 is the ion yield due to recombination of ions and 1·70 the ion yield due to other mechanisms. Possible mechanisms of that part of the reaction consequent on ion recombination and of that part of the reaction independent of ion recombination are discussed. AUTHORS.

1961. Exchange Character of Nuclear Forces from the β-Decay Theory. K. Nakabayasi. *Tohoku Univ., Sci. Reports,* **26.** *pp.* **261–281,** *Dec.,* **1937.** *In German.*—The interaction forces between nuclear particles are calculated from the β-decay theory. Even apart from the fact that the order of magnitude of the forces is much too small, it is not possible to choose the constants in the theory in such a way that the forces come out correctly in all cases as regards relative order of magnitude, spin dependence and saturation. R. P.

1962. Evidence Against the Existence of Heavy β-Particles. A. Ruark and C. C. Jones. *Phys. Rev.* **53.** *pp.* **454–456** *and* **496,** *March* 15, **1938.**—By studying collisions of Ra E β-particles with electrons, photographed in the cloud chamber by Champion, it is shown that Jauncey's hypothesis of heavy β-particles definitely disagrees with experiment.

AUTHORS.

***1963. Focusing in the Cyclotron. M. E. Rose.** *Phys. Rev.* 53. *pp.* 392–408, *March* 1, 1938.—It is shown theoretically that the effect of inhomogeneities, in both the electric and magnetic fields in the cyclotron, is to exert a focusing action on the ions. The electrostatic focusing predominates in the first part of the path and the magnetic focusing in the latter part. The magnetic focusing is in general more efficient. The important factors in focusing and the effects of changes in the fields are discussed, leading to a statement of the best types of fields for good focusing. To obtain high energies particular magnetic fields are necessary in order that an appreciable ion intensity may be obtained. Such fields are described and values are given of the maximum proton, deuteron or α-particle energies obtainable when the peak voltage on the dees is 50 kV. With increasing dee voltage $2V_0$ the maximum energy increases only as $V_0^{1/2}$. It is pointed out that these high energies can be obtained only by very careful "shimming." G. O. B.

***1964. Focusing in the Cyclotron. R. R. Wilson.** *Phys. Rev.* 53. *pp.* 408–420, *March* 1, 1938.—A quantitative study of the electrostatic and magnetic focusing of ions in the cyclotron has been made on the basis of electric and magnetic field measurements. The relative importance of the two effects is found to depend on the path radius of the circulating particles, with the electrostatic action effective at small radii and the magnetic focusing predominant at large radii of path. The particles are found to oscillate about the median plane; the amplitude of oscillations due to the electrostatic field increases as $r^{3/4}$, while the amplitude due to the magnetic field varies as $(-r\partial H/\partial r)^{-1/4}$ for ions in phase. Calculations of the vertical motions of the ions as they move outwards agree with probe measurements made on the cyclotron at Berkeley. Changes in accelerator electrode design are suggested which would enable larger high frequency input voltages to be obtained. G. O. B.

***1965. Use of an Ionisation Chamber with a Liquid Dielectric. L. Goldstein and A. Rogozinski.** *Comptes Rendus,* 206. *pp.* 835–837, *March* 14, 1938.—Some preliminary results are described in which an ionisation chamber filled with hexane is used for the detection of γ-radiation and neutrons from an RaAc + Be source. It is shown that such a chamber can be used to detect the neutron yield. G. O. B.

***1966. Simple Scale-of-two Counter. H. Alfvén.** *Phys. Soc., Proc.* 50. *pp.* 358–359, *May* 2, 1938.—In a recent paper Lewis [see Abstract 4917 (1937)] described a scale-of-two counter using hard vacuum tubes instead of thyratrons. The author describes a scale-of-two counter similar to that of Lewis, but a little simpler. A one-step scale of two of this kind has been used in recording cosmic rays at a rate of about 100 impulses per minute, but it can equally well be used in high-speed counting. There are no critical circuit constants, as there are for counters using oscillating valves for example. The counter has worked perfectly with no adjustments at all during several months of continuous counting, for 10^7 impulses.

See also Abstracts 1764, 1977, 1993, 2162.

RADIATION.

ABSORPTION.

1967. Influence of Temperature on the Excitation of Colour Centres. H. Pick. *Ann. d. Physik*, 31. 4. *pp.* 365–376, *Feb.*, 1938.—The way in which the absorption of colour centres in KCl, KBr and NaCl alters with the progress of excitation, is discussed and illustrated with absorption curves. The quantum efficiency of the optical transformation of F centres into F′ centres depends considerably on temperature and can rise in the case of KCl to a value of 2. An explanation of this value is given. Excitation is confined to a definite temperature range and the highest percentage of F centres transformed depends on the temperature. An explanation of the temperature variation is given in terms of the overlapping of the absorption bands of F and F′ centres and of the decrease of mean life of F′ centres with temperature. J. E.

***1968. Applicability of Christiansen Filters. K. v. Fragstein.** *Ann. d. Physik*, 31. 5. *pp.* 443–452, *March*, 1938.—Continuing previous work [see Abstract 3478 (1933)] on the use of Christiansen filters for the selection of narrow u.v. spectrum bands, the author describes means for overcoming the susceptibility of these filters to changes in room-temperature and atmospheric pressure. Sealing-off of the filter system and independent heating of the filter cell and of the tube connecting the cell to the Hg filled U-tube which incorporated the Pt contacts for the temperature control, proved effective. A new combination of powdered solid and surrounding liquid to give spectrum bands down to about 250 $m\mu$ is indicated. The intensities obtainable with the Christiansen filters are compared (by calculation) with those yielded by a simple prism monochromator. W. S. S.

See also Abstract 1929.

COLORIMETRY.

1969. Intrinsic Properties of the Colour Domain. L. Silberstein. *Kodak Research Lab., Comm. No.* 658. *J.O.S.A.* 28. *pp.* 63–85, *March*, 1938.—The author is concerned in the first place with the representation of colours as points in the Euclidian plane. He concludes that this is a valid representation with respect to colour mixture phenomena. He then considers metrical properties and defines a colour geodesic between two colours A and B as that chain of colours leading from A to B which consists of the least number of just perceptible differences. In the absence of adequate experimental data on the least perceptible differences, a form of Fechner's law is assumed. It then appears that no plane representation of colours correctly reproduces the metrical properties and a surface of variable curvature must be used. The theory outlined refers to colours of equal brightness. When brightness is allowed to vary the problem complicates. Metrical properties cannot be correctly represented by a Euclidian three-dimensional model. Earlier contributions on this subject, by Schrödinger and Bouma respectively, are criticised. W. S. S.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1970. Thermal Variation of the Cotton-Mouton Constant for Liquid Aromatic Hydrocarbons. C. F. Squire. *Comptes Rendus*, 206. *pp.* 514–515, *Feb.* 14, 1938.—In the Cotton-Mouton effect and the Kerr effect the constants should be independent of temperature. Their variation with temperature is probably due to a forbidden transition becoming possible under the close juxtaposition of molecules in the liquid state. H. G. C.

1971. Light Vibrations in a Medium in an Alternating Magnetic Field. G. Zanotelli. *Accad. Lincei, Atti,* 26. *pp.* 393–397, *Dec.* 5, 1937. —An experimental study of the paramagnetic rotation of the plane of polarisation in an alternating field has been previously described. [See Abstract 4143 (1934).] The modification of the form of the emergent light due to a change in the magnetic field during the passage of the light through the medium is now considered from a theoretical point of view. It is found that there is a diminution in the maximum rotation from that calculated from the Verdet formula. With an alternating field of frequency 5×10^8 per sec., and a path length of 30 cm., the instantaneous maximum rotation amounts to about 64% of the obtained with a constant field of magnitude equal to the maximum value of the alternating field. For light of wave-length 6000 Å, the distance between the emergent components is 6×10^{-3} Å, which can be detected with an interferometer. C. J. B. C.

EMISSION.

1972. Non-Relativistic Theory of Particles with Integral Spin. A. Proca. *J. de Physique et le Radium,* 9. *pp.* 61–66, *Feb.,* 1938.—A former theory is developed [see Abstract 1194 (1937)] to show that a three-component theory, each component satisfying the Schrödinger equation, describes to a Newtonian approximation a particle with integral spin and positive kinetic energy. The magnitudes associated with the particle, and their relations, are investigated, and it is shown that the theory can be applied to particles of a low-velocity heavy-electron type. N. M. B.

1973. Spherical Waves in Photon Wave Mechanics. J. Géhéniau. *Comptes Rendus,* 206. *pp.* 653–655, *Feb.* 28, 1938.—On the basis of the de Broglie wave theory of light a simple general demonstration is deduced of the theorems of conservation of total impulse moment associated with a multipolar emission. N. M. B.

1974. Wave-Length of Radiation Emitted by Electrified Insulators—Theoretical Interpretation. F. Perrier. *Comptes Rendus,* 206. *pp.* 831–833, *March* 14, 1938.—The coefficients of absorption (μ) in celluloid of the radiation emitted by frictionally electrified amber, sulphur and ebonite are respectively 230, 490, and 740 cm.$^{-1}$, *i.e.,* in the reverse order of the dielectric constants (2·19, 3·10 and 3·50). μ_{air} of naphthalene (K = 2·5) is 2·6 cm.$^{-1}$, and of B_2O_3 1·5. The law of Bragg and Pierce states that the frequency (ν) of this radiation varies inversely as μ^3. It is hence deduced that ν is of the order of 10 Å. It is proportional to the difference in potential between opposite faces of the dielectric, hence if this is small the radiation is no longer ionising, and is therefore not detectable by the electrometer. C. A. S.

1975. X-Particle. A. Bramley. *Science,* 87. *pp.* 281–282, *March* 25, 1938.—It is suggested that Dirac's model particle having the same charge as an electron but a spin greater than ½ should be identified with the X-particle the existence of which has been established from cosmic-ray investigations. A summary is given of the properties of the X-particle to be expected on the basis of the latest Dirac theory. N. M. B.

1976. Propagation of Light in an Atomically Stratified Medium. J. Weigle. *Helv. Phys. Acta,* 11. 2. *pp.* 159–180, 1938.—The author develops the mathematical theory of light propagation in a medium each element of which is assumed to be optically isotropic but which exhibits a continuous periodic variation of refractive index in one direction, the period of this variation being of the order of one thousandth the wavelength of the light. It is shown that such a medium exhibits double refraction although this is not directly comparable with the double refraction of crystals because of the anisotropy associated with the individual atoms in the latter case. The calculation yields the intensity of laterally diffused light, which although relatively very weak might in certain conditions be observable experimentally. W. S. S.

1977. Theory of Neutrinos. G. Wataghin. *Comptes Rendus*, 206. *pp.* 425–427, *Feb.* 7, 1938.—The author has shown previously that Einstein's gravitational equations can be derived from a system of equations of the first order relative to four matrices of the fourth order γ^μ which are connected with the gravitational potentials $g^{\mu\nu}$ by Tetrode's relations, $\gamma^\mu\gamma^\nu + \gamma^\nu\gamma^\mu = 2\, g^{\mu\nu}\cdot 1$. The particles obtained by quantising the field of the γ^μ are here identified with the neutrinos. An explanation of nuclear forces and β-ray emission is developed on this basis. W. S. S.

1978. Neutrino Theory of Light. M. H. L. Pryce. *Roy. Soc., Proc.* 165*A*. *pp.* 247–271, *April* 5, 1938.—This paper brings to light a grave difficulty for the neutrino theory of light. Starting from assumptions about the neutrino sufficiently general to include the models which have been studied by Jordan, Kronig and others (with the exception of Scherzer's attempt, which is not strictly a neutrino theory), and working with the amplitudes of the second quantisation as the most suitable mathematical apparatus, one sets up the most general theory consistent with Jordan's hypothesis. The conditions under which this will lead to a satisfactory theory of light are (1) that certain commutation rules be satisfied; (2) that the theory be invariant under a change of coordinate system. In order to study the second of these it has been necessary to analyse rather carefully the transformation of the amplitudes under certain types of rotation and this reveals an arbitrariness in the choice of certain phases. A condition for the invariance of the theory is that the results be independent of the way in which these phases are chosen. From this point onward a straightforward analysis leads to the result that the conditions cannot be satisfied simultaneously. The invariance requires that the neutrino which interacts with the atom should reverse its spin, a result which could also be derived from considerations of the conservation of angular momentum, and an essentially simple though rather tedious calculation shows this to be inconsistent with the commutation rules. The introduction gives an account of the aims of the neutrino theory of light, the problems which it meets and the attempts that have been made to solve them. AUTHOR.

1979. Absorption of Cosmic Radiation in Various Materials. A. Sittkus. *Zeits. f. Physik*, 108. 7–8. *pp.* 421–438, 1938.—The absorption of the hard component of cosmic radiation (filtered through 25 cm. Pb) due to Pb, Fe, Al, C and paraffin in thicknesses between 100 and 1000 gm./cm.^{2} was measured by the coincidence-counting method. An absorption coefficient of $5\cdot 7 \times 10^{-4}$ per gm./cm.^{2} was found to fit closely all these materials. Although good agreement with the results of other workers using coincidence-counting was obtained, there is considerable divergence, which cannot be satisfactorily explained, from results derived from ionisation chamber measurements. D. H. F.

1980. Ionising Power of Cosmic Rays. E. Stuhlinger. *Zeits. f. Physik*, 108. 7–8. *pp.* 444–453, 1938.—The ionising power of cosmic rays has been determined by a method which is described. The hard primary radiation produces 30 to 35 ion pairs per cm. of air at 1 atm., the shower rays under similar conditions produce about 50 ion pairs. The difference in the ionising powers of the two components is discussed on the assumption that the hard cosmic primary rays are very fast protons. W. R. A.

1981. Altitude Effect on the Specific Ionizing Power and Zenith Angle Distribution of Cosmic Rays. D. K. Froman and J. C. Stearns. *Canad. J. of Research*, 16. *Sect. A. pp.* 29–40, *Feb.*, 1938.—Measurements made with a quadruple-coincidence Geiger-Müller counting system at altitudes of 120 and 14160 ft. give the intensity, J, of cosmic ray ionising particles at various zenith angles, ψ. The distribution, $J_{(\psi)} = J_0 e^{-0 \cdot 175 \psi} \cos^2 \psi$, does not differ significantly from any measured values, and agrees with all observations within 0·5 and 3·0% of the vertical intensities at the lower and higher altitudes respectively. The total number of rays incident per unit area per unit time was found, and the specific ionisation was determined by comparison with ionisation chamber measurements. The results are given below :

Altitude, ft.	120	14,160
Mean specific ionisation in ion pairs per cm. in air at one atmosphere, i	54·8 ± 1·8 82·0 ± 2·6	87·5 ± 6
Total number of rays incident per hour per cm². of level surface, N_1	78·3 ± 2·5	306 ± 22
Total number of rays incident per hour per cm². of surface normal to the rays, N_2	109 ± 3·5	425 ± 30
Number of vertical rays incident per hour per cm². per unit solid angle, J_0	58·4 ± 1·9	228 ± 15

AUTHORS.

1982. Latitude and Asymmetry Effects on Cosmic Rays. O. Godart. *Ann. Soc. Sci. de Bruxelles*, 58. *pp.* 27–41, *March* 19, 1938.—Determination of the characteristic exponents of periodic trajectories. [See also Abstract 4682 (1936).]

1983. Penetrating Component of Cosmic Radiation. T. Grivet-Meyer. *Comptes Rendus*, 206. *pp.* 833–835, *March* 14, 1938.—In studying the properties of the hard component in cosmic radiation, Geiger counters surrounded by 10 cm. of Pb are used at depths equivalent to 10, 30 and 75 m. of water. Results for the mass absorption coefficients are given in a table. The significance of the results is discussed. G. O. B.

1984. Cosmic Radiation and Magnetic Storm of Jan. 1938. W. Kolhörster. *Naturwiss.* 26. *pp.* 159–160, *March* 11, 1938.—Measurements of the vertical intensity with two independent double-coincidence counting sets over a period including the magnetic storm of Jan. 16th and the aurora display of 25th Jan. showed a pronounced fall in intensity corresponding to the accompanying variation in the earth's magnetic field in each case, a maximum fall in intensity of about 8% and 6% being observed on the two occasions respectively. D. H. F.

1985. Variations of Cosmic Radiation during Magnetic Storms. T. H. Johnson. *Terr. Mag.* 43. *pp.* 1–6, *March*, 1938.—The experimental values of the geomagnetic cosmic-ray effects have been used in calculating the change of cosmic-ray intensity during a magnetic storm on the assumption that the magnetic disturbance can be regarded as a variation of the earth's magnetic moment. The change in moment found necessary to produce the observed variations of cosmic-ray intensity during the storm of April 1937, is of the order 150 times greater than any value simply reconcilable with the magnetic disturbances recorded. Authors.

1986. Terrestrial Magnetism and Cosmic-Ray Intensity. V. F. Hess, A. Demmelmair and R. Steinmaurer. *Terr. Mag.* 43. *pp.* 7–14, *March*, 1938.—Certain relations between the variations of the earth's horizontal magnetic force H and of the observed cosmic-ray ionisation J have been found in the continuous registrations of the cosmic-ray ionisation on the Hafelekar, 2300 m. above sea-level during the year 1936–37 as follows: (1) A positive magnetic effect, ME_1, is indicated during magnetic storms with increase of J associated with increase of H and *vice versa*. A similar effect has been noticed rather often also in the daily mean values of J and H during magnetically undisturbed days. ME_1 amounts to $+0 \cdot 57$ per mille of the cosmic-ray ionisation for an increase of the horizontal force by one γ ($0 \cdot 00001$ gauss). (2) The analysis of the daily mean values for one year discloses a second effect, ME_2, of opposite sign (increase of H accompanied by decrease of J) and smaller than ME_1. ME_2, for the average of the year 1936–37, is about $-0 \cdot 20$ per mille per γ. (3) A similar negative magnetic effect, ME_3, is found from the strong correlation between the diurnal variation of H and J; $ME_3 = -0 \cdot 2$ per mille per γ. (4) Another negative effect, ME_4, can be derived from the anti-parallel variations of the monthly means of H and J (seasonal curves); $ME_4 = -1$ per mille per γ. The three first-mentioned effects can be explained qualitatively by adopting the hypothesis of the electronic ring-currents in the outer space around the globe. The seasonal effect is not yet explained and it seems possible that its connection with terrestrial magnetism is accidental, in spite of the strong correlation. Authors.

1987. Intensity of Primary Cosmic Radiation and Its Energy Distribution. T. H. Johnson. *Phys. Rev.* 53. *pp.* 499–501, *April* 1, 1938.—The number of primary cosmic rays incident upon 1 cm^2. (horizontal) at the top of the atmosphere is computed by dividing the total energy spent in ionisation in an infinitely deep column of air by the average energy of a single primary ray. The energy is found by integrating under the ionisation-depth curves of Bowen, Millikan, Neher and Haynes and the average energy per ray is computed from the minimum energy of the Lemaître-Vallarta theory and a suitably chosen distribution function. Evidence for a low energy limit at $4 \cdot 4 \times 10^9$ V is found. The number of primary cosmic rays increases from $0 \cdot 03$ per cm^2. per sec. at the equator to $0 \cdot 36$ per cm^2. per sec. at latitudes above 45°. The total cosmic-ray current to the earth is 8×10^{17} rays per sec. or $0 \cdot 13$ A. If the distribution function is of the form AV^{-n}, where V is the energy of a ray and n and A are constants, it is shown that n is equal to or slightly less than 3. Author.

1988. Scattering of Cosmic-Ray Particles in Metal Plates. P. M. S. Blackett and J. G. Wilson. *Roy. Soc., Proc.* 165*A*. *pp.* 209–215, *April* 5, 1938.—Measurements have been made of the multiple scattering of cosmic rays in the following metal plates: $0 \cdot 33$ cm. lead, $1 \cdot 0$ cm. lead, $2 \cdot 0$ cm. copper. The range of values of $H\rho$ of the tracks extended from 10^5 to 3×10^7 gauss-cm., corresponding to electron energies of 3×10^7 to 9×10^9 eV. The observed average angle Θ of the multiple scattering is found to be nearly inversely proportional to the measured values of $H\rho$, and to be in fairly close agreement with the prediction of theory for rays of any mass, but with velocity nearly equal to c. At high energies the observed values are somewhat higher than expected. This

discrepancy, which may be partly due to experimental error, will be further investigated. This result, that the scattering of the penetrating component is normal, while the radiation loss is much less than that expected for electrons, gives support for a heavier rest mass for the rays. But this conclusion is not quite certain. [See also Abstract 1598 (1938).]
AUTHORS.

1989. Cosmic-Ray Ionisation near a Lead Block. E. G. Schneider. *Phys. Rev.* 53. *pp.* 615–617, *April* 15, 1938.—A study of the relative occurrence of the more frequent cosmic-ray phenomena near a 6 mm. thick sheet of lead has been made by analysing 2500 stereoscopic photographs of electron tracks. In order to avoid selectivity of the apparatus for certain types of events, the cloud chamber was not triggered by a counting device, but was operated by manual and mechanical controls. These photographs show that about three-quarters of the ionisation is due to single particles, about one-fifth is due to photon produced pairs, and approximately one-twentieth is caused by secondaries ejected by particles.
AUTHOR.

See also Abstracts 1761, 1835, 2202.

FLUORESCENCE AND PHOSPHORESCENCE.
LUMINESCENCE AND AFTERGLOW.

1990. U.V. Phosphorescence of X-Rayed Rock-Salt Crystals. M. N. Diatchenko. *Phys. Zeits. d. Sowjetunion*, 13. 1. *pp.* 55–64, 1938. *In English.*—The u.v. phosphorescence of NaCl crystals exposed to X-rays is investigated by means of a photoelectron counter. The time dependence of the intensity of the phosphorescence is found to be equal to $N = N_0 e^{-t/\tau_1}$, where the time constant $\tau_1 = 1 \cdot 86 \times 10^2$ sec. The threshold value for the phosphorescence reaches the maximum at 110 kV (the time of exposure being 3 min.). The wave lengths of the phosphorescence are found in the spectral region below 1900 Å, between 1900 Å and 2500 Å and in the visible region.
AUTHOR.

1991. Alkali Halide-Thallium Phosphors. F. Seitz. *J. Chem. Phys.* 6. *pp.* 150–162, *March*, 1938.—The long-wave length absorption peaks of phosphors not contained in pure alkali halides may be attributed to excitation of Tl ions. These are assumed distributed throughout the crystal, replacing alkali metal ions. The nature of the fluorescent and phosphorescent spectra is correlated with the behaviour of normal and excited levels during the time after absorption and before optical radiation in which the crystal again comes to mechanical equilibrium. Two cases are considered: that in which the excited Tl ion has no Tl ions among its 12 positive ion neighbours; that in which it has one. It is concluded that excitation to the lowest excited levels, associated with a triplet in the free ion, gives rise to fluorescence in either case, and that excitation to the higher, singlet level leads to the alternative possibility of phosphorescence in the second case, but not in the first. This means that homopolar forces between the excited ion and its neighbours depress singlet, more than triplet, excited levels, and that singlets are depressed more when one of the neighbours of a Tl ion is another Tl ion than when none are. A. H.

1992. Phosphorescent Zinc Sulphide. W. H. Byler. *Am. Chem. Soc., J.* 60. *pp.* 632–639, *March*, 1938.—A method of preparation of phosphorescent ZnS is developed by which samples with properties reasonably free of the influence of incidental variables may be prepared. Simple, objective methods for measurement of phosphorescence decay rate, fluorescence,

fluorescence growth rate, and α-particle response are developed. A group of samples in which certain significant factors were varied was prepared and studied. The decay of phosphorescence after the first few seconds was found to correspond to a series of second-order reactions. The total initial phosphorescence intensity was found to be greater after an intermediate period of excitation than after either shorter or longer periods. The effect of temperature on rate of decay was studied and activation energies for the several processes of decay were calculated. Some of these were found to be negative. Two samples containing Ni were shown to exhibit the vanishing type of phosphorescence. Certain relations between luminous properties, composition, and heat treatment with bearing on the theory were observed and are discussed. A theory of phosphorescence is outlined.
AUTHOR.

1993. Luminescence and Colour Excited by Radium in Glasses. B. E. Cohn and S. C. Lind. *J. Phys. Chem.* 42. *pp.* 441–452, *March*, 1938.—The luminescence produced by the exposure to Ra of zinc borate glasses which contain Mn indicates that the ordinary rules which govern activators are applicable when Ra is the source of the excitation. The optimum concentration of Mn in zinc borate glasses when the luminescence is excited by exposure to Ra is 0·05% of Mn. Exposure to Ra produces a change in visible colour which reaches a maximum at approximately 0·5% of Mn. The violet tint developed is caused by a greater relative absorption in the long wave-length region of the visible portion of the spectrum. Exposure to radium results in a general increase of absorption in the u.v. portion of the spectrum. For each wave length in the u.v. region there is a curve which represents the change of absorption as a function of the Mn concentration, and each of these curves has a maximum. The maxima of absorption in the u.v. region occur at the same concentrations as luminescence optima. From the results it is inferred that the u.v. absorption is closely related to the luminescence which is emitted when the specimens are heated. The initial visible and u.v. transparencies are almost completely restored by heating for prolonged periods at temperatures at or above 300° C.
AUTHORS.

INTERFERENCE, DIFFRACTION AND SCATTERING.

1994. Production and Properties of Wide-Angle Optical Interference Phenomena. P. Selényi. *Zeits. f. Physik*, 108. 7–8. *pp.* 401–407, 1938.—Detailed experimental instructions are given for the production of the wide-angle interference phenomena first discovered by the author in 1911; some new observations with regard to these phenomena are also described. In agreement with the previous results it is shown that the elementary light emission is propagated in spherical waves all parts of which are coherent and that in respect of intensity distribution these waves have the characteristics of a dipole radiation.
J. E. K.

1995. Diffraction, Mach Effect and Supplementary Fringes. F. Wolfers. *J. de Physique et le Radium*, 9. *pp.* 57–60, *Feb.*, 1938.—The supplementary fringes observed in the diffraction of light at a straight edge from a large source are explained on the basis of the Mach physiological effect and the sinuosities in the intensity distribution curve. Applications of the effect are suggested.
H. G. C.

***1996. Microscopic Examination of Gratings with Periodic Ruling Faults. H. Siedentopf.** *Zeits. f. Physik*, 108. 5–6. *pp.* 279–287,

1938.—Microscopic investigations of spurious images and ghosts produced by ruled gratings are correlated with errors in the rulings as revealed under microscopic examination. [See Abstract 5304 (1937).] C. B. A.

See also Abstracts 1771, 2009, 2010.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1997. Photo-Decomposition of Adsorbed Acetone. W. Kudrjawzewa and N. Prileshajewa. *Acta Physicochimica*, 8. 2. *pp.* 211–226, 1938. *In English.*—The photo-decomposition of acetone, adsorbed on Bi and Sb layers, is investigated in two regions of its absorption spectrum: 3200–2500 Å and 1950 Å and less. For this purpose spectrally decomposed light is projected on a thin metallic mirror, serving as adsorbent. Photochemically produced free methyl radicals react with the metal to form volatile metal-alkyls, which are easily removed by the pumps. The speed at which the mirror disappears at different places of the spectrum, serves as a measure for the efficiency of the corresponding wave-lengths. In order to determine exactly the limit of the photo-decomposition of the adsorbed acetone the method of crossed spectra was applied. In both regions of absorption the limit was found to be shifted in comparison with the gas phase in the direction of long waves. In the first absorption region this shift was 0·5 V, in the second 1·0 V. The investigation of the potential energy surfaces of acetone molecules shows that the observed displacement of the limit—apart from a small correction—is caused by the decrease of the distance between the electronic levels in the adsorbed molecules. AUTHORS.

1998. Mercury Photosensitised Decomposition of Ethane. E. W. R. Steacie and N. W. F. Phillips. *J. Chem. Phys.* 6. *pp.* 179–187, *April*, 1938.—An investigation of the Hg photosensitised decomposition of ethane has been made, the products of the reaction being analysed by low temperature fractional distillation. It is found that by improved trapping methods it is possible to remove butane from the system as formed, and thus the formation of secondary products is entirely inhibited. Under these circumstances the products of the reaction consist exclusively of methane, propane, and butane, the hydrogen and higher hydrocarbons found in previous investigations being secondary products of the propane and butane decompositions. The quantum yield (in terms of ethane disappearing) is approximately 0·2. The suggested mechanism of the reaction is: $C_2H_6 + Hg(2^3P_1) = 2CH_3 + Hg(1^1S_0)$; $CH_3 + C_2H_6 = CH_4 + C_2H_5$; $2CH_3 = C_2H_6$; $2C_2H_5 = C_4H_{10}$; $CH_3 + C_2H_5 = C_3H_8$. AUTHORS.

1999. Photosensitisation by Titanium Dioxide. C. F. Goodeve and J. A. Kitchener. *Faraday Soc., Trans.* 34. *pp.* 570–579, *April*, 1938. A study has been made of the bleaching by light of a powder made by dyeing TiO_2, with Chlorazol Sky Blue. The course of the bleaching at $\lambda = 365\ m\mu$ was followed by measurements of the quantum efficiency, and it was found that after an initial slow period the quantum efficiency was dependent upon the concentration of "vulnerable" dye molecules. A slight reduction in the rate of bleaching was found with increase in temperature. The parts played by the dye and the solid oxide have been shown by a study of the variation of the quantum efficiency with wave-length. Special methods of technique have been developed for these purposes. AUTHORS.

2000. Mercury Hypersensitisation of Photographic Plates. F. L. Whipple, D. Norman, R. Loevinger. *Harvard Coll. Obs., Bull. No.* 907. *pp.* 36–38, *Jan.* 1, 1938.—The authors tested the findings of Dersch and Dürr on the Agfa Ansco plates; of Smelhurst on Ilford S.S. Pan, Rapid Process Pan, and Agfa Iso Pan ISS, by this process. In each test a plate was cut in two, and each part sealed in separate glass containers, one being dry, the other having free Hg, each pair being developed simultaneously in a standard manner. They found for Cramer Hi-Speed Special (only) that the gain in sensitivity was about 3/10ths of a magnitude, and was independent of the plates being sensitised before, after, or during exposure, contrary to the results of the Agfa people. In astronomical photography of faint light sources the gain in sensitivity at low density levels produces a real gain in the effective speed of the emulsion. A. S. D. M.

2001. Influence of Surface Active Anions and Kations on Halogen Silver Sols and Photographic Emulsions. Part I. A. Lottermoser and R. Steudel. *Kolloid Zeits.* 82. *pp.* 319–335, *March,* 1938.—Examines the effects of surface active anions and kations on Ag halides, extending the results of Schwarz on negative AgBr sols by obtaining results with positive sols, and determining whether the use of such ions offers any assistance in the manufacture of photographic AgBr emulsions. From the results obtained it is found that the type of charge on AgI is determined solely by the surface-active ions used with it, this effect being independent of excess of Ag or I ions, and of the production of the sol either with surface-active ions present or added subsequently. The results also tend to suggest that an acceptor can only act as such if it is absorbed by the surface of the Ag halide particles. The conclusions of Schwarz are supported by results obtained for negative AgBr sols, but the actions of reducing anions or kations are reversed if used with positive sols, this reversal in action being in agreement with the surface charge theory. R. C. F.

2002. Limits of Infra-Red Sensitisation. G. Kornfeld. *J. Chem. Phys.* 6. *pp.* 201–202, *April,* 1938.—The competition between the thermal reaction and the photochemical reaction will set a natural limit to the extension of photographic methods into the infra-red region. From plausible assumptions concerning the velocity of the spontaneous reaction of molecules containing an excess of energy, it is concluded that this limit will be found at a wave-length of 2μ. AUTHOR.

2003. Progress of Colour Photography. D. A. Spencer. *Phot. J.* 78. *pp.* 226–229, *April,* 1938.

2004. Year's Progress in Kinematography. R. H. Cricks and I. D. Wratten. *Phot. J.* 78. *pp.* 267–269, *April,* 1938.

***2005. Photoelectric Densitometer. O. H. Ingber and K. Schwerin.** *Soc. Franç. Phot. et Ciné, Bull.* 25. *pp.* 3–8, *Jan.,* 1938.—Describes the construction of a photoelectric densitometer suitable for obtaining density values either by transmitted or reflected light. The light reaches the photo-cell after passing through a Goldberg wedge, the adjustment of which enables the reading of a milliammeter, indicating the amplified photo-current, to be kept at the same value whatever the density being measured. A scale on the adjusting handle of the wedge gives a direct reading of the density value. R. C. F.

***2006. Flare in Schmidt Cameras. C. H. Smiley.** *J.O.S.A.* 28. *pp.* 130–132, *April,* 1938.—The flare pattern obtained when a heavy overexposure is made with a Schmidt camera on a bright object well off-axis consists of a secondary image, haloes about the primary and secondary images and annulus with these images at extremities of a diameter. The bearing of this flare pattern on the design of a Schmidt camera is discussed and it is shown how one may test a Schmidt camera by the use of its flare pattern. AUTHOR.

See also Abstract 2040.

PHOTOMETRY.

2007. Relative Luminosity of Radiation at Wave-Lengths 5780 and 5461 Å for the Average Photometric Observer. J. S. Preston. *Phys. Soc., Proc.* 50. *pp.* 398–408, *May* 2, 1938.—The relative luminosity of radiation of wave-lengths 5780 and 5461 Å has been determined for sixteen observers whose mean Y/B ratio was 1·003, using the Guild flicker photometer with 2° field, and a field illumination of 25 to 30 lux. The corresponding relative energy measurements were made with a calibrated emission type photo-cell. The source of light was a high-pressure Hg discharge lamp with selective colour filters to isolate the two spectrum lines concerned. The results show good agreement with the value based on the luminosity factors adopted internationally in 1924 by the Commission Internationale de l'Éclairage. The paper includes details of the filters used, the method of calibration of the photo-cell, and investigations on the linearity of response and possible colour-selectivity of the thermopile used for the calibration. The question of the influence of field-size on the results is examined and discussed also. AUTHOR.

***2008. Recording Photoelectric Spectroradiometer. V. M. Albers and H. V. Knorr.** *J.O.S.A.* 28. *pp.* 121–123, *April,* 1938.—A recording spectroradiometer has been constructed for use in absorption spectra measurements in the visible and near infra-red regions. A Hilger quartz monochromator and an emission type photo-cell are used. The photo-cell current is amplified by a d.c. amplifier and the output of the amplifier actuates a Leeds and Northrup Speedomax recorder which produces an inked record. AUTHORS.

See also Abstracts 1930, 1935.

POLARISATION.

2009. Reciprocity Theorem in Colloid Optics. R. S. Krishnan. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 91–97, *Feb.*, 1938.—The effect of orientation of the particles on the reciprocity relation as well as on the intensity and state of polarisation of the scattered light has been studied for the case of graphite sol. Magnetic fields were employed as the external orientating agency. The depolarisation factors, ρ_u, ρ_v and ρ_h of the transversely scattered light have been measured with the magnetic field (1) perpendicular to the incident beam and the direction of observation, (2) parallel to the direction of observation and (3) parallel to the direction of the incident beam. The values of ρ_u, ρ_v and ρ_h are found to satisfy the reciprocity relation only when the magnetic field is perpendicular to both the incident and the scattered beams. In the other two cases the reciprocity relation is not satisfied. Marked changes are observed in the intensities of the components $\overline{V}_v$, $\overline{H}_v$, $\overline{V}_h$ and $\overline{H}_h$ and also in the values of ρ_u, ρ_v and ρ_h. [See also Abstract 1623 (1938).] AUTHOR.

2010. Light-Scattering in Emulsions. Part I. R. S. Krishnan. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 98–103, *Feb.*, 1938.—Measurements of the depolarisation factors ρ_u, ρ_v and ρ_h have been made in some typical dilute simple emulsions. Two methods have been employed for the preparation of these emulsions: (1) by boiling a mixture of water and a few drops of the oil and (2) by pouring an alcoholic solution of the oil into a large quantity of water. The values of ρ_v and ρ_h are of the order of 0·5 and 2% respectively for most of the emulsions. Depolarisation measurements indicate that the droplets in the emulsions prepared by the first method are bigger in size than those in the emulsions prepared by the second method. The depolarisation factors exhibit appreciable dispersion. It is shown that the droplets in dilute simple emulsions are spherical in shape and that the observed finite values of ρ_v and ρ_h are due to the existence of depolarised secondary scattering. AUTHOR.

2011. Rotatory Dispersion of Sugars in Liquid Ammonia and in Water. H. Shiba and S. Tanabe. *Chem. Soc., Japan, Bull.* 13. *pp.* 3–10, *Jan.*, 1938. *In English.*—Rotatory powers at visible wave-lengths are recorded for *d*-glucose, *d*-fructose, *d*-galactose, α-methyl-*d*-glucoside, saccharose, lactose and maltose in water at ordinary temperatures, and for *d*-glucose, *d*-fructose, α-methyl-*d*-glucoside, saccharose and lactose in liquid NH_3 at temperatures from − 35° to − 50° C. C. B. A.

***2012. Zero Position of a Polarising Nicol. J. R. Collins.** *Rev. Sci. Instruments*, 9. *pp.* 81–82, *March*, 1938.—In determining the optical properties of metals by use of reflected polarised light, one source of error lies in determining the azimuth of the incident and reflected light. Until the work of Emberson, no great improvement had been made in the method of determining the zero setting of the nicol prisms. Emberson's method is very difficult in practice, and an attempt has been made to devise a method based on the reversal of the phase of the light vibrating in the plane of incidence at the polarising angle, but which could be carried out at angles of incidence sufficiently removed from the polarising angle that there would be sufficient light to make the measurements more easily. A plot of the azimuth of the reflected plane polarised light against the azimuth of the incident plane polarised light, gives a curve which is essentially straight in the neighbourhood of zero azimuth angles for the incident light. All the curves intersect at the zero azimuth. The method consists in setting the azimuth of the incident light at various values near zero and setting the analysing nicol for extinction in each case. This is repeated for another angle of incident and the intersection of the two curves enables the correct zero setting to be made. C. J. B. C.

See also Abstracts 1828, 2102.

REFLECTION, REFRACTION AND DISPERSION.

2013. Reflection of Plane Wave Pulses from Plane Parallel Plates. M. Muskat. *J. of Applied Physics*, 9. *pp.* 275–278, *April*, 1938.—A wave theory analysis is given for the reflection of wave pulses from plates, which heretofore has been treated by the methods of geometrical optics. The general theorem is proved that if the reflection coefficient for a harmonic wave system is exactly periodic in the frequency of the waves, the reflections from the plate due to an incident pulse will consist of a series of wave trains exactly the same form as the incident pulse. This theorem may be applied to electromagnetic waves polarised in and normal to the plane of incidence, longitudinal waves in fluid media, and transverse waves polarised normal to the plane of incidence in general elastic media, when absorptive and dispersive effects can be neglected. AUTHOR.

2014. Refractive Index and Dispersion of Distilled Water for Visible Radiation, at Temperatures 0 to 60° C. L. W. Tilton and J. K. Taylor. *Bureau of Standards, J. of Research,* 20. *pp.* 419–477, *April,* 1938.—All known requisites for precision and accuracy within $\pm 1 \times 10^{-6}$ in refractive index were employed in these determinations made by the minimum-deviation method using specially designed hollow prisms and Pt resistance thermometers. The data were adjusted by least squares and are represented by a general formula having 13 constants, the average of the 133 residuals being $1 \cdot 2 \times 10^{-6}$. A general double-entry table of refractive indices (6,776 listings) with temperature and wave-length as arguments has been computed to yield sixth-decimal data by linear interpolation. The maximum of refractivity of water is found to be near 0° C., but the exact temperature thereof is a function of wave length, with a total variation of approximately 0·5° C. for the visible spectral range. Other more specific tables of indices are given, and evidences of slight systematic errors are discussed. The attained precision is approximately as expected, but there is marked disagreement with some of Flatow's indices, which have been widely used and are the basis for the data on water as given in the International Critical Tables. The authors' opinions concerning the accuracy of their results are qualitatively confirmed by the medial relation of their data to all of those previously published, and quantitatively, within the temperature range 0 to 16° C., there is remarkably close agreement with the interferometrically determined indices of water, as reported by O. Jasse [see Abstract 1145 (1934).] AUTHORS.

See also Abstracts 1784, 1811, 1865, 2102.

SPECTROSCOPY.

2015. Determination of Caesium by Emission-Spectra. A. Iwamura. *Chem. Soc., Japan, Bull.* 13. *pp.* 260–265, *Feb.,* 1938. *In English.*—Solid sample electrodes were prepared from a CsCl solution, C and " sirupus simplex " [see Abstract 2677 (1931)] and the amount of CsCl was spectrographically determined with a sensitivity of 2×10^{-4}%. The analysis was conducted on sample electrodes containing 0·0005–0·015% of CsCl. Both the " method of comparison " and the graphical method were found to be applicable for the determination of CsCl with a fair degree of exactness, error being always within the permissible limit. [See following Abstract.] AUTHOR.

2016. Determination of Lithium by Emission-Spectra. A. Iwamura. *Chem. Soc., Japan, Bull.* 13. *pp.* 265–272, *Feb.,* 1938. *In English.*—Solid sample electrodes were prepared from C, " sirupus simplex" [see preceding Abstract] and varying amounts of LiCl, and the amount of LiCl was spectrographically determined with a sensitivity of 3×10^{-5}% with respect to the line at 6707·9 Å, and with that of 1×10^{-4}% with respect to the line at 6103·6 Å. The method of comparison was found to be applicable for the determination of LiCl throughout the range of 0·001–0·050%. Several samples containing Li were analysed by the graphical method and were found to contain $1 - 12 \times 10^{-3}$% of LiCl. Several samples of clay produced in Seto and Inuyama were found by the graphical method to contain 3×10^{-5}% of Li. AUTHOR.

2017. Quantitative-Spectrographic Analysis of Biological Material. Part III. D. R. McRae, G. O. Langstroth and J. S. Foster. *Roy. Soc., Proc.* 165*A. pp.* 465–473, *April* 27, 1938.—An internal standard method of quantitative spectrographic analysis, as applied in the determination of Na and K in glandular secretions, is described. The probable error in a determination is about 4%. By adding an appropriate foreign substance to the sample in such quantities that the character of the condensed a.c. spark discharge is determined by this substance, it is possible to use the same working curve for samples of considerably different composition. The sample and internal standard may be separately placed on the electrode by a pipette specially designed for accurate delivery of small volumes. The volume of a sample required for the determination of both elements is thus reduced to 0·01 cm³. By photographing the spectrum of the sample with an Sb absorption step-weakener before the spectrograph slit it is possible to obtain determinations for two or more elements from a single exposure. [See also Abstracts 4088 and 5007 (1937) and 1639 (1938).] AUTHORS.

***2018. Far Infra-Red Spectroscopy. H. M. Randall.** *Rev. Modern Physics*, 10. *pp*. 72–85, *Jan.*, 1938.—In this survey article devoted to the spectroscopy of the far infra-red is shown how the methods, etc., of near infra-red spectroscopy are being applied to the far infra-red. Experimental methods are described and details are given of various instruments, particularly of a self-recording, high resolution vacuum instrument. A brief survey is also made of problems awaiting solution. A. H.

2019. First Spark Spectrum of Manganese. C. W. Curtis. *Phys. Rev.* 53. *pp*. 474—481, *March* 15, 1938.—The analysis of the MnII spectrum has been extended to include a classification of over 700 lines arising from combinations between terms belonging to the quintet and septet systems. From four members of the $3d^5(^6S)nf\,^7f$ series an ionisation potential of 126,147 wave numbers has been calculated by means of a Ritz formula. Pictures have been taken and measurements made covering the range from approximately 800 to 6000 Å. A hollow kathode discharge was used as a source, with each of the three gases, He, A and Ne, as conducting media. AUTHOR.

2020. Structure of the 3^3D Term of MgI. K. W. Meissner. *Ann. d. Physik*, 31. 6. *pp*. 518–521, *March*, 1938.—From interferometric measurement of the lines $3^3P - 4^3S$ and $3^3P - 3^3D$ of MgI, excited by electron collisions with a Mg atomic beam, the structure and separation of the 3^3D term is deduced. It is found that the term is partially inverted the D_1 term lying higher than the D_3 term with the D_2 term lowest of all. The separations are abnormally small compared with the 3P separations; $D_2 - D_3 = 0{\cdot}017\ \text{cm}^{-1}$ and $D_3 - D_1 = 0{\cdot}012\ \text{cm}^{-1}$ compared with $P_1 - P_2 = 40{\cdot}71\ \text{cm}^{-1}$ and $P_0 - P_1 = 20{\cdot}06\ \text{cm}^{-1}$. The $3^3P_2 - 3^3D_3$ and $3^3P_2 - 3^3D_2$ components of the $3^3P_2 - 3^3D_{321}$ triplet are separately observed and measured; the $3^3P_2 - 3^3D_1$ component is not observable on account of its small separation from the $3^3P_2 - 3^3D_3$ components and its 80-fold smaller intensity. J. E. K.

2021. Broadening of the Hg Resonance Line 2536·7 Å with Increasing Density of Hg Vapour. G. P. Balin. *Phys. Zeits. d. Sowjetunion*, 12. 6. *pp*. 701–728, 1937. *In German.*—The breadth of the Hg line 2536·7 Å is investigated by the absorption method at a pressure of 7·3 mm. As far as possible all factors are taken into consideration which might influence the form and breadth of the emission line including the quantitative influence of the diffusely reflected light and the additional broadening due to the finite thickness of the emitting layer. In calculating the absorption the superposition of the hyperfine structure components of the line is considered. The line breadth obtained from the observations is considerably bigger than the theoretical value. A possible explanation of the discrepancy may be that the theory, in which the interaction of only two atomic oscillators is dealt with, only takes a part of the effects into account. J. E. K.

2022. Isotope Displacement in the Spectrum of MgI. K. W. Meissner. *Ann. d. Physik*, 31. 6. *pp.* 505–517, *March*, 1938.—The hyperfine structure of MgI lines in the region 8800 Å to 3800 Å is investigated interferometrically with high resolution, the spectrum being excited by electron collisions with a Mg atomic beam. In addition the wave-lengths of most of the observed lines are determined to a high degree of accuracy the Kr line at 5570·2890 Å being used as a standard of reference. The strongest lines of the $3^1P - n^1D$ and $3^1P - n^1S$ series are found to exhibit triplet structure the components of which are nearly equidistant, the longest wave component being much the strongest and the other two about the same intensity as one another. The frequency differences between components are different for the two series and, in the case of the $3^1P - n^1D$ series, decrease as *n* increases. The observed structure is interpreted as an isotope displacement effect, each Mg isotope Mg 24, 25 and 26 exhibiting its own individual line. From the observed line displacements the isotope term displacements of the 3^1P and some ^1D terms are calculated. The lines of the triplet $3^3P_{012} - 4^3S_1$ at 5183 Å are sharp single lines and show no isotope displacement effect. J. E. K.

2023. Hyperfine Structure of the Al Spark Line 2669·2 Å. R. Ritschl. *Phys. Zeits.* 39. *pp.* 287–288, *April* 1, 1938. *From the Reichsanstalt.*—The author has previously reported that the Al spark line 2669 Å possesses two hyperfine structure components. With improved apparatus, including in particular a quartz Fabry-Perot interferometer with plates coated with pure Al, the line is further resolved into three hyperfine structure components, the newly discovered component being much weaker than the original two and on the short wave side. The separations of the three components are measured as 0·165 and 0·114 cm^{-1}. The existence of the third hyperfine component of 2669 Å has also been deduced recently by Jackson and Kuhn [see Abstract 722 (1938)], who, however, observed it only as an unsymmetrical broadening of one of the other components. The aluminised étalons are thus instrumental in giving better resolution than the 25 plate reflecting echelon grating used by Jackson and Kuhn. J. E. K.

2024. Hyperfine Structure, Zeeman Effect and Isotope Shift in the Resonance Lines of Potassium. D. A. Jackson and H. Kuhn. *Roy. Soc., Proc.* 165*A*. *pp.* 303–312, *April* 5, 1938.—The intensity ratio of the hyperfine structure components of the resonance lines of K 39 was measured by the method of absorption in an atomic beam. The value 1·45 found agrees with the value required by the spin $\frac{3}{2}$ if allowance is made for the overlapping by the lines of the 14 times rarer isotope 41. The component of longer wave-length was the stronger, showing that the nuclear magnetic moment of K 39 is positive. By using three atomic beams in series, of collimation $\frac{1}{35}$, it was possible to resolve the lines of K 41 as two satellites on either side of the weak component of K 39. The ratio of the splittings of the lines of K 39 and K 41 is found to be 1·77, in good agreement with the value 1·80 found by Manley in magnetic deflection experiments. The magnetic moment of K 41 is positive, like that of K 39. The lines of K 41 have an isotope shift of + 0·0076 $cm.^{-1}$ relative to the lines of K 39. The theoretical centre of gravity shift, considering

K as H-like, is $+ 0\cdot0087$ cm.$^{-1}$. The Zeeman effect of the hyperfine structure of the line $4S_{\frac{1}{2}}$-$4^2P_{3/2}$ of K 39 was investigated. Each of the two π components was found to consist of four lines, proving that the nuclear spin of K 39 has the value $\frac{3}{2}$, in agreement with magnetic deflection experiments and the measurements of the intensity ratio of the hyperfine structure lines. The observed positions of the lines are in close agreement with the positions required by the quantum theoretical formulæ. AUTHORS.

2025. Nuclear Magnetic Moments. D. R. Inglis. *Phys. Rev.* 53. *pp.* 470–474, *March* 15, 1938.—The general regularity of observed nuclear magnetic moments confirms the theoretical expectation that the total spin angular momentum should be one-half or zero, and suggests further that the orbital and spin moments of protons and neutrons separately are approximately constants of the motion in most nuclei. The possibility is discussed that this separability of the orbital moments (as well as the spin moments) should be expected as a result of the customary exchange nature of the binding forces. The separability seems to be due to neutron excess and to a vestige of the shell structure of the Hartree model, in which the contributing neutrons are loosely coupled to the protons by exchange forces because of being in quite different states. The moments of potassium are singled out as having exceptionally simple structure. AUTHOR.

2026. Signs of Nuclear Magnetic Moments of Li^6 and K^{41}. J. E. Gorham. *Phys. Rev.* 53. *pp.* 563–567, *April* 1, 1938.—Nonadiabatic transitions between magnetic quantum states of atoms in an atomic beam were used to determine the signs of the nuclear magnetic moments of Li^6 and K^{41}. The nuclei of these isotopes were found to have positive magnetic moments. AUTHOR.

2027. Magnetic Moments of ${}^{151}_{63}Eu$, ${}^{153}_{63}Eu$, ${}^{185}_{75}Re$, ${}^{187}_{75}Re$, ${}^{79}_{35}Br$, ${}^{81}_{35}Br$. T. Schmidt. *Zeits. f. Physik*, 108. 7–8. *pp.* 408–420, 1938.—By application of formulæ given by Goudsmit and Fermi and Segrè to the results of hyperfine structure measurements, the following nuclear magnetic moments are derived :—${}^{151}_{63}Eu : \mu = 3\cdot4$; ${}^{153}_{63}Eu : \mu = 1\cdot5$; ${}^{185}_{75}Re : \mu = 3\cdot3$; ${}^{187}_{75}Re : \mu = 3\cdot3$; ${}^{79}_{35}Br : \mu = 2\cdot6$; ${}^{81}_{35}Br : \mu = 2\cdot6$; ${}^{35}_{17}Cl : \mu < 0\cdot3$; ${}^{127}_{53}I : \mu \sim 3$. At the end of the paper a table is given of all the nuclear moments determined to date. J. E. K.

2028. Fine Structure of the Nuclear Ground Level of ^7Li. G. Breit and J. R. Stehn. *Phys. Rev.* 53. *pp.* 459–469, *March* 15, 1938.—Calculations of the fine structure of the ground level of the ^7Li nucleus are made in order to throw light on the form of the interaction energy between pairs of nuclear particles, and show how, with approximate assumptions about the wave function, adjustable parameters should be chosen in order to obtain agreement with observed fine structure. A general rule simplifying the calculation of the spin-orbit interaction with a closed shell is developed for interactions between pairs of particles. An examination of considerations affecting the choice of parameters emphasises that at present the calculations are only qualitative. N. M. B.

2029. Calculation of Electron Affinities with the Help of New Extrapolation Formulæ for Optical Terms. M. Mamotenko and H. Hellmann. *Acta Physicochimica,* 8. 1. *pp.* 1–8, 1938. *In German.*—A new interpolation formula in an isoelectric series is deduced for the energy of two equivalent electrons outside a spherically symmetrical atomic nucleus, and is applied to the electron affinities of several metals. [See also Abstract 4976 (1937).] C. B. A.

2030. Term Values in Carbon. C. W. Ufford. *Phys. Rev.* 53. *pp.* 568–569, *April* 1, 1938.—The energies of the terms of the normal state of CI, $1s^2\ 2s^2\ 2p^2$, and of the excited state, $1s^2\ 2s\ 2p^3$, are calculated with one-electron functions for a self-consistent field. The effect of the interaction of $1s^2\ 2s^2\ 2p^2$ and $1s^2\ 2p^4$ is also included. Tables are given of the radial integrals, of the absolute energies of the terms, and of the separations of the terms. $1s^2\ 2s\ 2p^3\ {}^5S$ is found 3·16 volts above the ground state $2p^2\ {}^3P$. AUTHOR.

2031. Inner Rotation and Normal Vibrations of Ethane. Part I. E. Bartholomé and J. Karweil. Part II. W. Hunsmann. *Zeits. f. phys. Chem.* 39. *Abt.B.* 1. *pp.* 1–43, 1938.—Part I consists of a discussion of the infra-red and Raman spectra of ethane. The infra-red spectrum has been investigated between 200 and 3300 cm^{-1}. with a grating spectrometer with a KCl foreprism. The numerous bands found in this region are tabulated. The purpose of the investigation was to locate a fundamental band at approximately 750 cm^{-1}. which itself is forbidden, from the positions of the overtones and combination tones. The two symmetry types which are under discussion for the ethane molecule are D_{3h} (the H atoms attract each other and are situated opposite each other) and D_{3d} (the repulsion of the H atoms is greater than the attraction; one H atom of one CH_3 group is opposite the bisectant of the angle between two H atoms of the other CH_3 group). The selection rules for both symmetry types are given, and from a discussion of the spectrum it is concluded that ethane has the symmetry D_{3h}. The missing fundamental has the value 740 cm^{-1}. Part II gives the results of a renewed investigation of the specific heat of gaseous ethane between 94° K. and 150° K. The results do not confirm the calculations of Teller and Weigert, but show below 140° K. a steep decrease of the inner rotational specific heat of ethane to the value 0·40 at 95° K. The potential of the inner hindered rotation cannot be greater than the value 315 cal. which agrees with the frequency 740 cm^{-1} of the torsional vibration given above. The decrease in the rotational specific heat below 140° K. is attributed to the impossibility of transitions between the different ethane modifications. L. K.

2032. Infra-Red Reflection Spectrum of Glasses. F. Matossi and H. Bluschke. *Zeits. f. Physik,* 108. 5–6. *pp.* 295–313, 1938.—The infra-red reflection spectra of 23 glasses and of a number of B compounds have been observed in the spectral region 2–26 μ. All glasses containing Si show two strong characteristic bands at 9 μ and 22–23 μ. These two maxima of reflective power are assigned to the two active vibrations of the SiO_4-tetrahedron as in the case of the silicates. With increasing content of Pb and Ba the Pb and Ba glasses show a shift of the 9μ band to longer wave-lengths. This shift is caused by the weakening of the linkages between the SiO_4-tetrahedra through the influence of the Pb or Ba ions. A number of B compounds has been investigated in addition to the B glasses. The spectrum of these glasses can be interpreted as caused by the vibrations of a plane BO_3 triangle. The existing hypotheses on the vitreous state are discussed, and the influence of different atomic arrangements on the vibration spectrum are considered. The experimental results are in agreement with the hypotheses that glasses consist of minute and considerably deformed crystals. L. K.

2033. Use of Interference Spectrographs for the Study of Fine Structures in Molecular Spectra. S. Imanishi. *Chem. Soc., Japan, Bull.* 13. *pp.* 77–84, *Jan.*, 1938. *In English.*—Interference spectrographs may be conveniently used for the study of fine structure of rotational lines in molecular band spectra. The method is applied to the study of electronic fine structure of He bands, and to that of the band spectrum of AuH. In the latter case the results do not indicate the existence of a Au isotope of mass number 199. A. J. M.

2034. Infra-Red Absorption Spectra and Modes of Vibration of Disubstituted Benzene Derivatives. J. Lecomte. *J. de Physique et le Radium*, 9. *pp.* 13–26, *Jan.*, 1938.—The methods previously applied to monosubstituted compounds of benzene [see Abstract 2624 (1937)] are extended to the disubstituted compounds. The results for a number of ortho-, meta- and para-compounds are given. H. G. C.

2035. Complexity of CH Bands of Benzene Derivatives. Structure of Benzene. B. Barchewitz. *Comptes Rendus*, 206. *pp.* 512–514, *Feb.* 14, 1938.—The position of CH bands of monosubstitutes of benzene in the near infra-red depend on the sign and size of the electric moment of the substituted groups. In the case of disubstituted derivatives if the groups are identical the displacement is similar to that in the monosubstituted derivatives and increases in the order ortho-, meta-, and para-. If the groups are dissimilar for ortho-compounds the displacement is that imposed by the greater electric moment; for meta-derivatives the displacement is greater and the bands assymmetrical; for para-derivatives the bands are double, each possessing the approximate position of bands of the corresponding monosubstitutes. The behaviour of the bands which is influenced by the electronic constitution of the molecule suggests a three-fold symmetry of the molecule, but this does not contradict the six-fold symmetry deduced from observations in the far infra-red, where the phenomena concerned are chiefly mass effects. H. G. C.

2036. Infra-Red Absorption Studies of Hydrogen Bonds between Unlike Molecules. W. Gordy. *Am. Chem. Soc., J.* 60. *pp.* 605–612, *March*, 1938.—Transmission curves for several different concentrations of methyl alcohol in nitrobenzene are given for the region 2·5 to 3·7 μ, and the effects of nitrobenzene on the OH band are compared with those of other solvents. The effects of H-bonding on the OH band are discussed. A study has been made of mixtures of water with methyl cyanide, and previous work on dioxane–water mixtures has been extended to longer wave-lengths. Evidence for the formation of D-bonds between D_2O and acetone and between D_2O and dioxane has been obtained from observations of the spectra of mixtures of these liquids. $CHCl_3$ has been found to produce shifts to lower frequencies of certain bands of acetone, ethyl acetate, ethyl ether and dioxane. The possibility of the formation of H-bonds between $CHCl_3$ and these liquids is discussed. AUTHOR.

2037. Infra-Red Absorption Spectra of Hydrocarbon Vapours. D. Bărcă-Gălăteanu. *Soc. Roumaine de Physique, Bull.* 38. 70. *pp.* 109–131, 1938. *In German.*—The absorption spectra of several hydrocarbons in vapour state is studied between 2 and 16·5 μ, by means of a mirror spectrometer. The minimum of deviation variations are obtained with the aid of a special mechanical arrangement which is controlled by the observer at 5 m. distance. The angles are read with 1″ precision. The following hydrocarbons were studied (A) Acyclic saturated hydrocarbons: *n*-Dodecane (synthetic). New bands at 2·301, 2·341, 2·50, 4·568, 8·812 and 22·48 μ. The band at 3·4 μ is triple, *n*-heptane is studied for the first time. The results for these hydrocarbons are in good concordance with the Raman effect observations. *n*-Hexane. Four new bands in the region 2–3 μ. All these substances present an intense band at 14 μ. (B) Cyclic saturated hydrocarbons: cyclopentane (synthetic) and methylcyclopentane (synthetic) have spectra similar to those of napthalene. Cyclohexane and methylcyclohexane have no absorption bands between 13–14 μ, a fact that can be explained by the presence of an even number of C $-$ C bonds in the cycle. AUTHOR.

2038. Spectrum of HCN in the Photographic Infra-Red. E. Lindholm. *Zeits. f. Physik,* 108. 7–8. *pp.* 454–458, 1938.—Five new bands are recorded and their origins and significance in interpreting the structure of the molecule are discussed. W. R. A.

2039. U.V. Absorption Spectra of the Systems MoO_3-NaOH in Dilute Solutions. Z. Soubarew-Chatelain and A. Berton. *Comptes Rendus,* 206. *pp.* 669–671, *Feb.* 28, 1938.—Solutions in which MoO_3 : NaOH = 2 : 1 have a marked yellow colour which persists until the ratio is 1 : 1 when it begins to disappear. Complete discoloration does not take place, however, until the composition corresponds with the normal molybdate. It is concluded that the yellow colour arises from the formation of a silicomolybdic acid formed as a result of the NaOH dissolving silica from the glass containers. The colour is always most marked with freshly prepared solutions of NaOH. W. R. A.

2040. U.V. Emission Spectra of the Slow Thermal Decomposition of Sodium Azide. R. Audubert. *Comptes Rendus,* 206. *pp.* 748–750, *March* 7, 1938.—Four bands, at 1975, 2150, 2300 and 2400, are identified in the spectrum emitted during the slow thermal decomposition of NaN_3, corresponding with those observed for AgN_3 [Abstract 4039 (1937)]. It is concluded that the luminescent reactions accompanying the thermal decomposition of azides ought to have the same emission spectrum, probably associated with molecular nitrogen. C. B. A.

2041. Absorption Spectra of SO_2 and CS_2 in the Vacuum Ultra-Violet. W. C. Price and D. M. Simpson. *Roy. Soc., Proc.* 165*A*. *pp.* 272–291, *April* 5, 1938.—The absorption spectra of SO_2 and CS_2 have been investigated by means of a vacuum spectrograph down to 1000 Å. For both molecules the systems of bands can be divided into two classes: (1) those which exhibit wide vibrational structure, (2) those which exhibit little or no vibrational structure. The former class probably correspond to transitions to anti-bonding molecular orbitals, while the latter are due to the transitions of comparatively non-bonding electrons to excited orbitals, which are mainly atomic in character. In the case of SO_2, the extrapolation of the bands of class (2) to their limit gives a value of $12 \cdot 05 \pm 0 \cdot 05$ V for the ionisation potential of the molecule. A similar procedure for CS_2 yields the much more accurate values $10 \cdot 083$ and $10 \cdot 027$ V for ionisation to the two components of the doublet state ${}^2\Pi_g$ of CS_2^+ ($\Delta\nu = 436$ cm^{-1}.). The experimental evidence indicates that while CS_2 is slightly bent in the earlier stages of the excitation, it finally returns to a linear configuration in CS_2^+. A vibrational analysis of the bands of class (1) is also given, and some general features of the electronic spectra of polyatomic molecules are discussed. AUTHORS.

2042. Hydrogen Molecular Spectrum. H. Hasunuma. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 125–148, *Feb.*, 1938. *In English.*—An examination is made of the H_2 spectrum as emitted by an arc run in H_2. In general longer branches are observed than those observed in the ordinary Geissler tube discharge. Tables are given of all the observed lines, with eye-estimated intensities, whilst lines belonging to previously analysed bands are indicated. The remaining lines are mainly accounted for by extensions of known branches. An examination is made of the longer series of rotational terms thus made available in certain cases and it is found that the usual rotational term formula containing terms up to $K^2(K+1)^2$ is insufficient. By introducing the 3rd order term $K^3(K+1)^3$ the rotational terms up to about $K = 13$ can be well expressed but for higher levels the 4th order term $K^4(K+1)^4$ is needed. Various perturbation and uncoupling phenomena are also discussed. A. H.

2043. Band Spectrum of Thallium Hydride. Part I. B. Grundström and P. Valberg. *Zeits. f. Physik,* 108. 5–6. *pp.* 326–337, 1938.—The band spectrum of TlH is obtained in thermal emission from a King resistance oven and in emission from a light arc at about 500 mm. pressure. The spectrum is photographed from 4000 Å to 7500 Å in the first order of a 6·5 in. concave grating with a dispersion of 1·9 Å/mm. 16 bands are analysed and all exhibit marked predissociation phenomena. From analysis of the bands it is assumed that the bands originate from 5 electron states. It appears probable that in TlH decomposition takes place both by rotation and by intersection of potential curves. The rotation structure is described in detail. The detailed discussion of the electron configuration and the predissociation phenomena is to be given in Part II of this paper. J. E. K.

2044. Rotational Analysis of Bands of Lead Sulphide. H. Bell and A. Harvey. *Phys. Soc., Proc.* 50. *pp.* 427–435, *May* 2, 1938.—A rotational analysis has been made of the (6, 0) (7, 0), (9, 0), (2, 1), (3, 1) and (4, 1) bands of the A ← X system of lead sulphide as observed in absorption. The structure of the bands is that which would be given by a $^1\Sigma \leftarrow {}^1\Sigma$ transition. A least-squares fit of the B′ values obtained gives $B_e' = 0{\cdot}08560 - 29{\cdot}55 \times 10^{-5}(v' + \frac{1}{2})$ cm^{-1}. whilst $B_0'' = 0{\cdot}105614$ cm^{-1}. and $B_1'' = 0{\cdot}104741$ cm^{-1}. Other constants determined were $D_0'' = -2{\cdot}573 \times 10^{-8}$ cm^{-1}., $D_0' = -2{\cdot}508 \times 10^{-8}$ cm^{-1}., $r_e'' = 0{\cdot}7552$ A and $r_e' = 0{\cdot}8406$ A. The bands analysed were due to ^{208}PbS, whilst a considerable number of lines observed were accounted for as due to ^{206}PbS and ^{207}PbS. AUTHORS.

2045. Predissociation of Isotopic Molecules. E. Olsson. *Zeits. f. Physik,* 108. 5–6. *pp.* 322–325, 1938.—According to the usual half-classical calculations, the limiting curves for the predissociation of isotopic molecules should be the same, a result which is not in accordance with experiment, *e.g.,* for AlH and AlD. The deviations do, however, agree with a quantum mechanical formula derived by Kronig. C. B. A.

2046. Spectra of the Monoxides of Cerium and Praseodymium. W. W. Watson. *Phys. Rev.* 53. *pp.* 639–642, *April* 15, 1938.—Vibrational quantum assignments are presented for five sparsely developed emission band systems of CeO and one of PrO. Comparison is made with two known GdO systems (Piccardi) and one LuO system (Watson and Meggers). Nd has no evident oxide spectrum in the flame of the arc, and Meggers and Scribner report none for Yb and Tm. Reasons for the general poor development or complete lack of oxide band systems for a number of the rare earths are discussed. Fairly intense band systems seem to exist only for those earths having a *d* electron in their normal configuration. AUTHOR.

2047. Resolution of Luminescent Spectra Excited by U.V. Light. J. Ewles. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *p.* 416, *Jan.,* 1938.—The u.v. bands of CaO previously reported as resolved under kathode-ray excitation [see Abstract 1687 (1937)] have now been obtained and resolved under optical excitation. J. E.

2048. Fluorescence Spectrum of Autunite. S. Iimori and E. Iwase. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 771. *pp.* 372–376, *March,* 1938. *In English.*—It is confirmed that the spectrum of fluorescence given by autunite, a hydrous phosphate of U and Ca, when excited by u.v. rays, consists of 16 bands arranged into 3 series, each of which has the same wave-number interval $\Delta\nu = 8$ (in 0·1 mm.). All these fluorescence bands coincide approximately in the wave-length with those shown by sodium uranyl phosphate, excepting three bands which were not noted before in the fluorescence spectrum of the latter. The sample of autunite used for the investigation was that from Okuma Village, Fukushima Prefecture, Japan. Excitation of the fluorescence bands by blue and green light was also studied on the same specimen. AUTHORS.

2049. Quantum Mechanical Resonance and Internal Rotation. S. Mizushima and M. Kubo. *Chem. Soc., Japan, Bull.* 13. *pp.* 174–181, *Jan.,* 1938. *In English.*—The effect of single bond-double bond resonance upon internal rotation is discussed for some carboxylic acids and their derivatives *viz.*, dimethyl carbonate, methyl and ethyl chloroformate, and methyl acetate. It is found that in acids and esters the strong carboxylic resonance imparts the double bond character to the C–O bond of the actual " mesomeric " molecule to such an extent that almost complete inhibition of internal motion is realised at all ordinary temperatures, whereas replacement of the H in H-COOR by Cl or $-OCH_3$ group so greatly reduces this double bond character that internal oscillatory rotation of finite amplitude can take place about the C-O bond as axis. [See also Abstract 4082 (1937).] H. H. Ho.

2050. Motion of Ethylene Halide Molecules in Crystals as Revealed by the Raman Effect. S. Mizushima and Y. Morino. *Chem. Soc., Japan, Bull.* 13. *pp.* 182–189, *Jan.,* 1938. *In English.*—In the region of the unmodified line the crystalline ethylene halides exhibit some Raman lines which correspond to motions of a molecule as a whole, but not to internal normal vibrations. For ethylene bromide a considerable change in these low frequency lines was observed between the spectrum at − 40° C. and that at 0° C., caused probably at the transition temperature (− 24° C.) observed in the thermal measurements. The authors identify these lines with lattice frequencies and regard the transition point as the temperature when one dimensional molecular rotation begins. H. H. Ho.

2051. Normal Vibrations of Ethylene Halides. Y. Morino. *Chem. Soc., Japan, Bull.* 13. *pp.* 189–197, *Feb.,* 1938. *In English.*—In a previous investigation [see Abstract 1810 (1935)] the normal frequencies of $C_2H_4X_2$ were calculated, the CH_2-group being considered as one particle. This work is now extended to the mathematical treatment of C-H vibrations and their effects on chain frequencies, the molecule being considered as a system of 8 particles having 18 normal modes of vibration. Equations are derived giving the chain frequencies of $X-(CH_2)-(CH_2)-X$, the C-H valency frequency, the deformation of the H-C-H, and the deformation of the CH_2-group relative to the C-C axis. Comparison of the results is made with experimental data. H. H. Ho.

***2052. Automatic Prism Spectrometer for the Infra-Red. H. Gershinowitz and E. B. Wilson, Jr.** *J. Chem. Phys.* 6. *pp.*197–200, *April,* 1938.—A spectrometer has been constructed which contains two prisms, one of NaCl, the other of KBr, each in a Wadsworth-Littrow mounting. The prisms may be interchanged in the optical train without opening the spectrometer housing or disturbing the calibration. The recording system includes a Barnes-Matossi type amplifier using a photronic cell. The recording is done stepwise, so that the zero of the amplifying system, the intensity of the source and the intensity of transmitted radiation are measured at each setting of the prism table, which is moved by a ratchet device. AUTHORS.

See also Abstracts 1968, 2008, 2088, 2116, 2117, 2122.

VISION.

2053. Area and Visual Threshold. G. Wald. *J. Gen. Physiol.* 21. *pp.* 269–287, *Jan.*, 1938.—The variation of threshold with field area was measured in fields homogeneous in rod-cone composition. At 15° above the fovea, an increase in field diameter from 1° to 5° reduces the threshold sevenfold, at 25° above the fovea, tenfold. These changes are shown to follow qualitatively from simple statistical properties of the retinal mosaic. Analytical treatment leads to the expression $(A - n_t)^k I = C$, in which A = area, n_t = constant threshold number of elements, I = threshold intensity and k and C are constants. W. D. W.

2054. Binocular Summation during Dark Adaptation. R. J. Lythgoe and L. R. Phillips. *J. Physiol.* 91. *pp.* 427–436, *Jan.*, 1938.—Monocular and binocular light thresholds have been measured during the first 20 min. of dark adaptation for a white stimulus subtending 12½° at the eye. Central observation was used for four observers and peripheral observation for two observers. Binocular summation was found throughout the period of dark adaptation for all subjects and for both central and peripheral vision. The results can be represented approximately by the equation $1{\cdot}4\ \mathrm{Th}_{\mathrm{Binoc}} = \frac{1}{2}(\mathrm{Th}_{\mathrm{Right}} + \mathrm{Th}_{\mathrm{Left}})$. It was found that the binocular threshold is approximately the same as the monocular threshold for a test patch of twice the area. W. D. W.

2055. Response of Single Optic Nerve Fibres of the Vertebrate Eye to Illumination of the Retina. H. K. Hartline. *Am. J. Physiol.* 121. *pp.* 400–415, *Feb.*, 1938.—Action potentials in single optic nerve fibres of cold-blooded vertebrates have been obtained from intra-ocular bundles dissected off the anterior surface of the retina of excised opened bulbs. Responses in different single fibres from the same retina show different types of response. About 20% respond to illumination with a burst of impulses at a high frequency followed by steady discharge at a lower frequency which ceases when the light is cut off. About 50% show only a burst of impulses in response to the onset of illumination and another in response to cessation; no impulses are discharged during steady illumination. About 30% show no discharge either at onset of illumination or throughout its duration, but give a vigorous and prolonged discharge when the light is turned off. Fibres which give a response to onset and cessation of light also respond to an increase or reduction in intensity. Fibres giving only an "off" response, respond to a reduction in intensity, but not to an increase. Various other effects are also reported, including effects of dark adaptation, variation of latent period and frequency of impulses with illumination, responses from different parts of the retina and so on.
W. D. W.

2056. Visual Purple and Rod Vision. H. F. Blum. *Science*, 87. *pp.* 193–194, *Feb.* 25, 1938.—The spectral absorption curve of visual purple, although similar in form to the curve of relative sensitivity of the eye for low intensities (rod vision), is displaced by about 7 mμ towards the blue compared with the latter. The curves are brought into practical coincidence by converting the absorption values from relative energies to relative numbers of quanta. This procedure is in complete accord with the view which is almost certainly true that the visual receptor response is based on some sort of photochemical process. [Compare **H. J. A. Dartnall** and **C. F. Goodeve** : *Nature*, 139. *p*. 409, *March* 6, 1937]. W. S. S.

See also Abstracts 1969, 1995.

X-RAYS.

2057. Theory of Scattering of X-Rays by Crystals of Variable Structure. I. M. Lifschitz. *Phys. Zeits. d. Sowjetunion*, 12. 6. *pp*. 623–643, 1937. *In English.*—General formulæ are derived for the scattering of X-rays from lamellar crystals of variable structure. A series of special cases is discussed. A simplified model of the mechanism of the formation of a variable structure crystal is examined and interference formulæ for this model are obtained. AUTHOR.

2058. Focusing of X-Ray Beam by a Rock-Salt Crystal. R. M. Bozorth and F. E. Haworth. *Phys. Rev.* 53. *pp*. 538–544, *April* 1, 1938.—A single crystal of rock-salt (halite) has been bent plastically and cut so that X-rays of a narrow range of wave-lengths coming from the focal point of the X-ray tube, are focused at another point. In this way the divergent beam from the X-ray tube (about 6° divergence) is monochromatised and concentrated so that the intensities of the Fe $K\alpha$ lines are about 30 times as great as when monochromatised by reflection from a plane crystal. The point of focus was placed on the reflection circle of a Seeman-Bohlin focusing camera and powder photographs were taken, the advantage over the usual arrangement being that the background (due to undesired wave-lengths) is much diminished without any serious loss of intensity in the lines. AUTHORS.

2059. Lα Satellites for Element 82 (Pb). M. Valadares and F. Mendes. *Comptes Rendus*, 206. *pp*. 744–746, *March* 7, 1938.—Nine components are measured in the complex band on the short wave-length side of Lα_1 in the spectrum of Pb, and six of them are identified by comparison with the spectra of neighbouring elements. A similar band (very faint) is observed for α_2. C. B. A.

2060. Lα and Lβ lines of the Elements from Fe to Ge, and of their Compounds and Alloys. E. Gwinner. *Zeits. f. Physik*, 108. 7–8. *pp*. 523–541, 1938.—The Lα and Lβ emission lines of a large number of compounds and alloys of the elements with atomic numbers between 26 and 32 are studied, including a number of new satellites. The width and shape of the lines depends very much on the chemical state. In particular the oxides show a line shape different from all other forms. In the case of Fe_2O_3 even the ratio of the intensities of Lα to Lβ is different from the value it has in pure Fe. R. P.

2061. Theory of Continuous X-Ray Spectrum near the Duane-Hunt Limit. E. Brunner. *Phys. Rev.* 53. *pp*. 457–459, *March* 15, 1938.—The effect on the distribution of energy in the continuous X-ray spectrum in the immediate vicinity of the Duane-Hunt limit of the extranuclear electrons in the atoms composing the target of the X-ray tube is considered. Resonance effects are found to occur which are capable of explaining the knee recently discovered by DuMond and Bollman in the isochromat very close to the threshold [see Abstract 2149 (1937)].

AUTHOR.

2062. Effect of Electrode Thickness and Disposition on X-Ray Measurements. W. Wehrheim. *Phys. Zeits.* 39. *pp.* 174–180, *March* 1, 1938.—It is shown theoretically and experimentally that the effect of electrode thickness and spacing in a small ionisation chamber for absolute measurements of X-rays, is quite appreciable. As a result of secondary electrons produced in the chamber striking the electrodes before completing their ionisation the chamber becomes dependent on wave-length to an extent depending on the dimensions of the electrodes. This effect can be eliminated by using varying electrodes and extrapolating to zero diameter. A formula is given by means of which corrections for electrode size can be made. It is shown that in the Küstner arrangement the effect of the electrodes is less than 0·3%. J. E. R.

***2063. Integrated Intensity of Powder Photographs. E. O. Wollan.** *Rev. Sci. Instruments,* 9. *pp.* 79–81, *March,* 1938.—The photographic method of measuring X-ray intensity has now been developed so that in many applications it is as accurate as the ionisation method. It is usually necessary to take several photographs. The usual procedure is that in which calibration marks giving intensity *vs.* blackening are put on the film, and these marks used to convert the microphotometer traces to intensity traces, the resulting curve being integrated with a planimeter. A partly graphical method is described which greatly reduces the labour of this process without any sacrifice in accuracy. An integrating slide rule is described. C. J. B. C.

2064. X-Ray Spectroscopic Determination of La, Nd and Gd in the Presence of Other Rare Earth Elements. K. Kimura. *Chem. Soc., Japan, Bull.* 13. *pp.* 10–27, *Jan.,* 1938. *In English.*—La in a rare earth mixture can be determined by comparing the intensity of its $L\beta_2$ line with that of the Ce $L\beta_3$ line. Nd in a rare earth mixture can be determined by comparing the intensity of its $L\alpha_1$ line with that of the Ce $L\beta_1$ line. Gd in a rare earth mixture can be determined by comparing the intensity of its $L\alpha_1$ line with that of the Nd $L\beta_2$ line.

AUTHOR.

HEAT.

CALORIMETRY.

See Abstracts 1802, 1826, 1827, 2079.

CONDUCTION.

2065. Heat Flow in Laminated Materials. R. Størmer. *Wiss. Veröff. a. d. Siemens-Werken,* 17. 1. *pp.* 90–98, 1938.—Mathematical investigation is made of the temperature equilibrium of a body composed of any number of parallel laminæ of equal cross-sectional area, but each layer consisting of a material having different thermal constants. A complete solution is obtained for the variation of temperature distribution with time for the special case in which the body cools from a stationary

initial temperature distribution. By way of an example the case of a wall composed of equal thicknesses of oak, cork and cement is evaluated.
R. W. P.

2066. Partition of Heat Flow in Double Wall Methods. P. Vernotte. *Comptes Rendus*, 206. *pp.* 505–508, *Feb.* 14, 1938.—The author is concerned with the propagation of heat in two walls, which may be of different materials and of different thicknesses, enclosing a thin heating layer. Emphasis is laid on the control of heat flux rather than of temperature. If the contact between the walls and the heater is assumed perfect then at the initial instant of switching on the heater the heat fluxes to the two walls will be the same whatever their characteristics. The importance of this result in determining thermal properties by the method of heat signal is discussed. W. S. S.

2067. New Solution of Heat Flow Problems. P. Vernotte. *Comptes Rendus*, 206. *pp.* 590–592, *Feb.* 21, 1938.—The problem considered is that of the cooling of a one dimensional system. Formulæ suggested by Laplace and by Fourier were considered by the latter to become identical though differing in form. It is now thought that this only holds for the large time-values in which Fourier was interested, and that Laplace's equation should be used when studying the initial period of cooling. As this equation, in its original form, cannot readily be solved a method is described whereby it can be used to obtain solutions for this initial period. [**Erratum,** *ibid. p.* 1152, *April* 4, 1938.] R. W. P.

2068. Effect of Magnetic Fields on the Thermal Conductivity of Gases. E. Rieger. *Ann. d. Physik*, 31. 5. *pp.* 453–472, *March*, 1938.—A method has been developed and employed to determine the variation with temperature of the effect of magnetic fields on the thermal conductivity of gases, and numerous results are given. It is shown that the effect is a function of $H/p(1 + C/T)$. For large values of the mean free path second-order deviations from this law occur. To account for the variation of the effect over a wide range of the variables p, T and H it is shown that it is necessary to employ the product of two functions, $f\{H/p(1 + C/T)\} \times g\{T/p(1 + C/T)\}$. R. L.

2069. Thermal Conduction in H_2–D_2 Mixtures. C. T. Archer. *Roy. Soc., Proc.* 165*A*. *pp.* 474–485, *April* 27, 1938.—The paper describes an experimental investigation of thermal conduction in H_2, D_2, and H_2-D_2 mixtures of varying concentration. The hot-wire method, used by the author and others previously in similar work was adopted to determine the thermal conductivity at 0° C. of H_2, D_2, and of each mixture, and also the accommodation coefficients of H_2 and D_2 relative to a Pt surface at 0° C. The H_2 was prepared from distilled water, the D_2 from D_2O of 99·95% guaranteed concentration, and the gaseous mixtures from mixtures of the water and D_2O, by passing the vapour over Mg heated to about 500° C. in an electric furnace. D_2 was also prepared from the oxide by reaction with metallic Na *in vacuo*. The percentage concentrations of the gaseous mixtures were obtained from observations of the densities of the liquid mixtures, using a flotation method. The values obtained of the thermal conductivity at 0° C. of H_2 and D_2 were $0\cdot000418_2$ and $0\cdot000308_0$ cal. cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$ C., and of the accommodation coefficient $0\cdot29_6$ and $0\cdot37_6$ respectively. The values of the thermal conductivities of all the gases together with the percentage concentrations are shown in a table, and also represented by means of a graph. AUTHOR.

2070. Thermal Conductivity of Liquid Helium II. W. H. Keesom, A. P. Keesom and B. F. Saris. *K. Onnes Lab., Leiden, Comm. No.* 252*d. Physica,* 5. *pp.* 281–285, *April,* 1938. *In English.*—The heat conductivity of liquid He II in a capillary, length 35 cm., width 0·30 mm., was examined. It appears to depend on the amount of heat flow, the heat conductivity decreasing when the heat flow increases. As a function of temperature it has a very pronounced maximum at 1·7–2·0° K. Heat conductivities of about 810 cal.sec^{-1}. cm^{-1}. deg.$^{-1}$, that is more than 800 times that of Cu at room-temperature, were measured. [See also Abstract 2781 (1936).] AUTHORS.

2071. Thermal Conductivity of Crystals at Low Temperatures. W. J. de Haas and T. Biermasz. *K. Onnes Lab., Leiden, Comm. No.* 251*b. Physica,* 5. *pp.* 320–324, *April,* 1938. *In German.*—The thermal conductivities of SiO_2 and KCl are investigated in the range 24°–2° K. with a number of specimen thicknesses. It is found that a minimum occurs in the thermal-resistance/temperature curve for both crystals, and that the specific resistance is smallest with thick specimens. In the case of KCl, the specific thermal resistance at these low temperatures is approximately inversely proportional to the thickness. Owing to the possibility of reflection of waves of heat at the boundaries between crystallites composing the mosaic crystal, the present experiments do not disprove the theoretical result that with an infinitely large ideal crystal the resistance will approach zero with diminishing temperature. A. G. Q.

See also Abstracts 2090, 2202.

CONVECTION.

2072. Motion of a Fluid Heated from Below. R. J. Schmidt and O. A. Saunders. *Roy. Soc., Proc.* 165*A. pp.* 216–228, *April* 5, 1938.—If a horizontal layer of fluid, initially at rest, is heated from below, instability and cellular motion set in when λ ($\equiv agc(\theta_1 - \theta_2)d^3/k\nu$) is about 1700. Experiments for several layer depths show that on further heating the layer becomes completely turbulent at about $\lambda = 45000$. Observations by an optical method indicate that in the case of water the turbulence develops suddenly, but that in air the transition is more gradual, the first signs of turbulence occurring at about $\lambda = 5000$. The rate of heat transfer is measured at each stage, and the increase at the change from cellular to turbulent motion is found to be less than that at the change from equilibrium to cellular motion. In the cellular motion the length of the horizontal side of a cell is found to be twice the layer depth. The vertical temperature gradients at positions on the plane midway between the boundary surfaces decrease progressively to negligible values as the motion develops with increasing λ. In the turbulent motion the fluctuating vertical temperature gradients are very small on the mid-plane. The horizontal gradients are very small on the mid-plane, but have maxima at positions between the mid-plane and either boundary surface. [See also Abstract 5089 (1935).] AUTHORS.

DILATATION.

See Abstract 1774.

FUSION AND SOLIDIFICATION.

2073. Melting Temperatures of Compounds Adsorbed on Silica Gel. W. A. Patrick and W. A. Kemper. *J. Phys. Chem.* 42. *pp.* 369–380, *March*, 1938.—The Andrews calibrated heat conduction method was used to measure the heat capacity of substances adsorbed on silica gel. Water, naphthalene, benzene, and *p*-nitrotoluene, were investigated in various concentrations. [See also following Abstract.]

2074. Effect of Surface Forces on Melting. W. A. Patrick and W. A. Kemper. *J. Phys. Chem.* 42. *pp.* 381–390, *March*, 1938.—The Patrick equation for adsorption is extended below the normal melting point of the sorbate by using as values for normal vapour pressure, surface tension, and specific volume, those of supercooled liquid sorbate. A general equation is obtained for the melting temperature of substances condensed in porous adsorbents. Calculations are made of the melting temperatures of the four substances adsorbed on silica gel reported in the previous paper [see preceding Abstract.] The calculations used only two constants characterising the gel, *k* and *n* of the Patrick equation. The values employed for those were obtained from a study of adsorption isotherms of benzene and water on this gel at higher temperatures. The temperatures at which the last portions of the sorbates were calculated to have melted averaged only 14° C. lower than the temperatures at which the maxima in the heat capacities of the systems had been observed. It is believed that the calculated temperatures are lower because of hysteresis. Further equations are derived from the various terms which compose the difference between heat capacity of the sorbate in the adsorbed state and in its normal solid state. The results of these calculations are compared with the observations reported in the previous paper. AUTHORS.

See also Abstracts 2075, 2095.

TEMPERATURE.

2075. Reproducibility of the Ice Point and the Triple Point of Water. J. A. Beattie, Tzu-Ching Huang and M. Benedict. *Am. Acad., Proc.* 72. *pp.* 137–155, *Jan.*, 1938.—The reproducibility of the ice point is of importance in connection with the international temperature Scale, and work previously carried out is first discussed. The factors affecting the ice point are pressure, purity of ice and water, saturation of the ice with water. All these are considered at some length and formulæ are given for their calculation. Factors affecting the triple point of water are pressure, purity of ice and water, thickness of the ice film, radiation and conduction. Values for these corrections are deduced and a formula giving the triple point is derived from the Clapeyron equation. The value is $+ 0{\cdot}0099°$ C. $\pm$ $0{\cdot}0001°$ C. Apparatus is then described for the measurement of the triple point, and full details of the methods are given. The experimental value was $0{\cdot}00981 \pm 0{\cdot}00005°$ C. The paper includes tables of conductance of water, and freezing points of water saturated with air at different temperatures. E. H. D.

***2076. Thermoregulator for Experiments of Long Duration. N. Sălăgeanu.** *Soc. Roumaine de Physique, Bull.* 38. 70. *pp.* 103–108, 1938. *In French.*—The author describes a thermoregulator, which maintains its sensitivity during a long time interval. It uses the capillary forces of the mercury meniscus formed at the upper end of a thermometer, which interrupts the heating current by raising a small Pt plate forming the contact. AUTHOR.

***2077. Reutter's Heat Engine. H. Bock.** *Zeits. f. Instrumentenk.* 58. *pp.* 123–126, *March*, 1938.—A meter which incorporates the principles of Reutter's heat engine has been produced for some time by a Swiss firm. Essentially it consists of a pivoted closed U-tube, partially filled with Hg and having NH_3 vapour in the upper portion of each limb. One limb is shielded from changes in atmospheric temperature, whereas the other quickly follows such changes. The present paper discusses the oscillations of the instrument, which result from a rise or fall of the surrounding temperature, in terms of its dimensions and the physical properties of the vapour it contains. The instrument is very compact and has been adapted to give continuous records of the movements, and hence of variations in temperature. R. W. P.

2078. Thermodynamic Temperature Scale below 1° K. W. F. Giauque and D. P. MacDougall. *Am. Chem. Soc., J.* 60. *pp.* 376–388, *Feb.*, 1938.—This paper is a full account of work, summaries of which have already been published. Gadolinium phosphomolybdate tridecahydrate has been demagnetised adiabatically to temperatures below 1° Abs., and the adiabatic differential susceptibilities have been measured up to fields of 8000 gauss and down to temperatures of 0·13° K. The measurements form the basis of a new experimental procedure for determining the intensity of magnetisation as a function of the field, a knowledge of the temperature corresponding to zero field not being necessary. Full details of the experiments and of the method of calculating the results are given and the theoretical implications are considered together with the results of other workers. It was shown that when the material was demagnetised to these low temperatures there was no residual magnetism. An induction heater of a Au-Ag alloy was devised to introduce heat for heat capacity determinations, and it was found that Au is not a supraconductor at temperatures down to 0·11° K. These measurements enabled the first determination of thermodynamic temperature to be made in the region made available by the magnetic cooling method. It is found that the thermodynamic scale agrees with the temperatures predicted by Curie's law for gadolinium phosphomolybdate down to 0·15° K. The temperature change during adiabatic magnetisation has been tabulated and the energy change during isothermal magnetisation at 1·4° K. has been shown to be practically zero, as would be expected for an ideal paramagnetic substance. [See following Abstract.] E. H. D.

***2079. Induction Heaters for Calorimetry below 1° K. W. F. Giauque and J. W. Stout.** *Am. Chem. Soc., J.* 60. *pp.* 388–393, *Feb.*, 1938.—It has been shown experimentally [see preceding Abstract] that induction heaters are well adapted to calorimetry below 1° K., one big advantage being the absence of direct electrical connections, eliminating heat leak. The resistances of a number of Au-Ag alloys have been investigated and the results are tabulated and discussed. Formulæ are given for the heat developed by spherical, cylindrical and ring type heaters, and a simple calculation of the heat developed and of the limiting temperatures in a spherical heater is given. The variation of resistance with magnetic field has also been investigated and it is evident that Au-Ag induction heaters could be used in the presence of large magnetic fields without appreciable correction. With one alloy a negative magnetic coefficient of resistance was found and previously this has only been found for ferromagnetic metals. E. H. D.

See also Abstracts 1856, 1857, 2071.

THERMOCHEMISTRY.

2080. Thermochemistry of Sulphur Compounds. M. Brutzcus. *Comptes Rendus*, 206. *pp.* 838–840, *March* 14, 1938.—In similar fashion [see Abstract 5391 (1937)] the thermochemistry of S compounds is dealt with, the value 228·3 kg.cal. for the addition of O_2 to the molecule being equally applicable ; if the S is ionised 83·9 kg.cal must be added. Dissociation of S : S absorbs 102·5 kg.cal. (the spectroscopically determined amount is 101·7). Other examples are given including the evaluation of the bonds S-H (84·5 kg.cal.), and C-S (86·5). C. A. S.

THERMODYNAMICS.

2081. Thermodynamic Properties of Hydrocarbons. W. C. Edmister. *Indust. and Engin. Chem.* 30. *pp.* 352–358, *March*, 1938.—The effects of pressure on specific heats at constant pressure, entropy, and enthalpy are computed in reduced or generalised units for hydrocarbons. These calculations are based on a new correlation of P.V.T. data. The effect of temperature on these thermodynamic properties can be computed by a new equation for specific heat at 1 atm., which is based on a correlation of the data of Beeck, of Eucken and Lüde, and of Eucken and Parts. By means of a table of generalised thermodynamic properties and equations presented in this paper, it is possible to compute all the thermal properties for any hydrocarbon for which critical data are available. AUTHOR.

2082. Thermodynamic Properties of Helium at High Pressure. W. Jacyna. *Am. Chem. Soc., J.* 60. *pp.* 555–558, *March*, 1938.—Starting with the thermodynamic equation of state for helium—which covers the whole range of experimental data of Holborn and Otto, Kamerlingh Onnes and Boks, Keesom and Kraak, Bridgman, Wiebe, Gaddy and Heins, and others from 2 to 800° Abs. and from 15000 kg./cm². to zero—are given (1) the tabular and graphical comparison and synthesis of several experimental vp-data at high pressure ; (2) the thermodynamic properties of helium : the "volume-work" vp, the specific volume v and volume-deviation Δv, coefficient of expansion a, specific heat C_v, C_p, $C_p - C_v$ and the ratio $C_p/C_v = k$, Joule effect μ_u and Joule-Thomson effect μ_i, which all are computed in the region from − 70 to 200° C. and from 103·3 to 30000 kg./cm². and respectively tabulated. AUTHOR.

2083. Equilibrium Isotherms and Isobars of CO-N_2-H_2 Mixtures. V. Fischer. *Ann. d. Physik*, 31. 6. *pp.* 531–539, *March*, 1938.—Verschoyle's experimental results [see Abstract 516 (1932)] are employed in the representation of the equilibrium isotherms at − 185° C. and − 205° C. and the equilibrium isobars at 150 and 30 atm. of CO-N_2-H_2 mixtures, using a plane orthogonal system of coordinates. The general differential equation representing equilibrium between the liquid and vapour phases of a ternary mixture is used to derive a relation between maximum values of T and p characterising the various curves. [See Abstract 799 (1935).] J. S. G. T.

2084. Joule and Joule-Thomson Effects. A. L. Clark and L. Katz. *Canad. J. of Research*, 16. *Sect. A. pp.* 41–59, *Feb.*, 1938.—This paper contains material not treated in a previous paper [see Abstract 897 (1924)]. It deals particularly with the Joule and Joule-Thomson effects at low and at high pressures and also near the critical point. These effects have been calculated by various methods from available data. The value of the internal pressure (Joule effect) has been calculated (for the first time) for the two-phase, liquid-vapour state, and compared with values obtained from the equation of state. This internal pressure is nearly a linear function of the external pressure. The values of the internal pressure have also been calculated for low pressure where values have been in doubt. The behaviour of the specific heat at constant volume as a function of the temperature has also been studied and related to the behaviour of the internal pressure. The inversion of the Joule and Joule-Thomson effects is examined. The internal pressure evidently rises to a maximum as the pressure is increased at constant temperature, and probably falls off to zero and becomes negative. For helium the pressure for inversion is relatively low. The inversion curve for the Joule-Thomson effect has also been studied, and it is shown that even for carbon dioxide an inversion of the effect may be expected. When the values of the two effects are small we must have recourse to experimental methods because the calculations cannot be made with accuracy. When, however, these values are large, calculations yield results of good accuracy, probably better than may be obtained by experiment. AUTHORS.

2085. Determination of Intermolecular Forces from the Joule-Thomson Coefficients. J. O. Hirschfelder, R. B. Ewell and J. R. Roebuck. *J. Chem. Phys.* 6. *pp.* 205–218, *April*, 1938.—The energy of interaction between nonpolar molecules is determined inductively from a study of the experimental Joule-Thomson coefficients. These coefficients have been measured very accurately for some substances, and in these cases our method of analysis is preferable to other methods which utilise less accurate data. It follows from classical statistical mechanics that: $\mu_0 = (-2\pi N/C_p{}^0) \times \int_0^\infty r^2[1-(1-E(r)/kT)\exp(-E(r)/kT)]dr$. Here μ_0 and $C_p{}^0$ are the Joule-Thomson coefficient and specific heat at constant pressure, respectively, both extrapolated to zero pressure; N is Avogadro's number; k is Boltzmann's constant; and $E(r)$ is the energy of interaction of two molecules separated by a distance r. This integral is evaluated using the Lennard-Jones form for the potential energy, $E(r) = -cr^{-6} + lr^{-s}$. Here c, l, and s are varied so as to give the best agreement with the experimental μ_0. The numerical tables required for these analyses are given. He and A are studied in detail. The necessary quantum corrections are made for He and shown to be negligible for A. The Joule-Thomson studies of Roebuck and Osterberg are found to be in accord with other P.V.T. measurements. It is shown that all substances having a mutual potential energy of the Lennard-Jones form with the same value for s, satisfy the theorem of corresponding states. Consequently, at low pressures, the Boyel point, T_B, is proportional to the Joule-Thomson inversion point, T_I, and $T_B = 0{\cdot}532\ T_I$. This relationship is verified in the case of N_2.
AUTHORS.

2086. Preparation for the Formation of New Phases. A. Smits. *Zeits. f. phys. Chem.* 39. *Abt.B.*1. *pp.* 50–58, 1938.—It is shown that recent investigations on liquid water, which indicate the complexity of the phases and the apparent associations present, confirm suggestions put forward by the writer 24 years ago. Van der Waals mentioned this apparent association, and the writer saw in it a preparation for the formation of new phases. Water has been shown to be formed of different pseudo-components which consist of the simple H_2O molecule and one or more polymers. The pseudo-system of water is at least a binary one, and the orientated apparent association has a complicated formation of indefinite structure. The apparent association has been revealed in the case of water by Bernal and Fowler [see Abstract 3951 (1933)], who found a broken ice structure at normal temperatures.

R. W. P.

2087. Thermodynamic Treatment of Theory of Solutions. K. Fredenhagen. *Zeits. f. Elektrochem.* 44. *pp.* 206–208, *March,* 1938.—A theoretical development and criticism of a basis for the thermodynamic treatment of the theory of solutions. F. J. B.

2088. Free Energy of Acetylene. A. R. Gordon. *J. Chem. Phys.* 6. *pp.* 219–220, *April,* 1938.—Making various assumptions as to vibrational levels and rotational constants, equations are obtained for the free energy. Again assuming thermochemical data the equilibrium constant of the reaction $C_2H_2+N_2=2HCN$ is calculated. G. G.

2089. Statistical Mechanical Treatment of the Absolute Rate of Chemical Reaction. J. Horiuti. *Chem. Soc., Japan, Bull.* 13. *pp.* 210–216, *Jan.,* 1938. *In English.*—In this paper a general discussion is given of the statistical method for treatment of the absolute reaction rate with a group of atoms having the following properties: (1) displacements of atoms taking place adiabatically with regard to electronic configuration; (2) classical mechanics holding for the motion of centres of gravity of atoms; (3) the group having more or less chance of interchanging energy with its surroundings at a definite temperature by interaction with radiation or with other material system; (4) the group being capable of stable existence in the initial and final states, which are distinctly different from each other in the spacial relative configuration of atoms. The rate constant of the reaction is the probability with which the chemical system transits from the configuration of the initial to that of the final state per unit of time. The transition and its probability are treated with special reference to the configuration space rather than to the phase space, and the probability is dealt with for three different types of flow of points arising from different magnitudes of the free path. H. H. Ho.

2090. H.F. Longitudinal Waves in Viscous Fluids. R. Lucas. *Comptes Rendus,* 206. *pp.* 658–659, *Feb.* 28, 1938.—The modification, arising from the viscosity of liquids, exerted on h.f. longitudinal waves is examined mathematically and it is shown that these waves may participate in thermal conductivity. N. M. B.

2091. Energy and Motion of Transverse Waves in Liquids. A. D. Fokker. *Physica,* 5. *pp.* 241–248, *April,* 1938. *In German.*—Transverse shearing waves in a liquid are accompanied by a quantity of motion in the direction of their propagation. This quantity of motion arises as a consequence of the warming of the liquid. The energy of the wave multiplied by a conversion factor and added to the quantity of motion gives a constant.This conversion factor is $V_{trans.}/V^2_{long.}\ (\partial U/\partial p)_v\rho$, which has the dimensions of the reciprocal of a velocity, and for a perfect gas is equal to $2\ V_{trans.}/3\ V^2_{long.}$ R. W. P.

See also Abstracts 1786, 1811, 1853, 1910, 2077.

VAPORISATION AND CONDENSATION.

2092. Distillation and True Boiling-Point Curves of Complex Mixtures. E. M. J. Pease. *J. Math. Phys.* 16. *pp.* 202–214, *Jan.,* 1938.—Mathematical paper in which the procedure is worked out of a method of obtaining a true boiling-point curve from a simple distillation curve. R. L.

2093. Water as a Reference Standard for Ebulliometry. W. Swietoslawski and E. R. Smith. *Bureau of Standards, J. of Research,* 20. *pp.* 549–553, *April,* 1938.—The properties of water are discussed with reference to its suitability as a primary standard for comparative ebulliometric measurements. The influence of small natural or accidental differences in isotopic composition with respect to the O as well as to the H isotopes is shown to be negligible. The equation of Beattie and Blaisdell is suitable for obtaining the building point of water to 0·001° C. or better at any pressure between 660 and 860 mm., and an equation, based on the data of the same authors, is given for obtaining the pressure in an apparatus from the measurement of boiling point. AUTHORS.

2094. Condensation on Board Ship. S. J. Duly. *Roy. Soc. Arts, J.* 86. *pp.* 439–453; *Disc.,* 453–455, *March* 25, 1938.—An account is given of some experiments on the absorption of water vapour by, and its release from commodities on board ship; rules for the ventilation of cargo are given. Stress is laid on the observations that (1) cargo tends to remain at its loading temperature during a sea voyage so that goods loaded cold are likely to remain cold and to arrive cold and (2) the air at sea is warm and damp over large stretches of ocean. It is pointed out that the warm damp air should not be admitted into the ship while the temperature of the cargo is lower than that of the dew point. Therefore ventilators should be closed as soon as the dew point of the air rises above the temperature of the cargo. R. L.

See also Abstract 2177.

ACOUSTICS.

2095. Formulæ for Calculation of the Velocity of Sound and of the Melting Point. R. Gianasso. *N. Cimento,* 14. *pp.* 486–491, *Dec.,* 1937.—In a previous communication [see Abstract 758 (1937)] formulæ were deduced for the calculation of the compressibility, coefficient of thermal dilatation and frequency of vibration of the crystal lattice. By semi-empirical calculations an expression is derived for the velocity of sound. This involves a constant which depends solely on the crystal type. There is excellent agreement between theory and experiment for a number of metallic elements. A formula for the calculation of the melting point gives values in accord with observation. All the expressions contain an empirically chosen whole number which may correspond to the number of valency electrons, but the experimental results, though numerous, are insufficient to permit a definite conclusion. C. J. B. C.

2096. States of Vibration of a Hollow Quartz Cylinder. Ny Tsi-Zé and Chung Ming-San. *J. de Physique et le Radium,* 9. *pp.* 52–56, *Feb.,* 1938.—In the present paper it is shown that in addition to longitudinal, rotational, radial and circular vibrations, a hollow quartz cylinder may also furnish vibrations which are transverse or analogous to those of a bell, and finally affords a vibration characterised by a frequency which depends only on the exterior radius of the cylinder. The observed frequencies are in good agreement with the values calculated from theoretical formulæ for isotopic matter. The various modes of vibration are illustrated by certain Chladni figures. H. H. Ho.

2097. Theory of Indian Musical Drums. Part I. K. N. Rao. *Indian Acad. Sci., Proc. 7A. pp.* 75–84, *Feb.*, 1938.—The paper contains a discussion of the normal modes of vibration of a symmetrically loaded membrane in which the surface density varies as an inverse fractional power of the radial distance from the centre, with a view to finding how far the harmonic sequence of tones observed in the Indian musical drum approximates to a law of density of this type. It is shown that for a law of density varying in inverse proportion to the radius, the first four modes with nodal diameters only, form an approximate harmonic sequence with the fundamental. With this law of loading, however, the relative frequencies of the symmetrical modes remain entirely unaffected (though their interior nodal circles contract, while the frequencies of the modes having both nodal diameters and nodal circles, require a greater degree of loading than that stated above to fall into the same harmonic sequence. The results thus show clearly that a type of loading so highly concentrated at the centre cannot succeed in reproducing completely the observed results. The indications are that a more widely distributed load such as is actually employed should theoretically be necessary to achieve the desired purpose. AUTHOR.

2098. Position of Vibrator in Experiments of Melde and Kundt. B. J. Miller and L. O. Olsen. *Acoustical Soc. of America, J.* 9. *pp.* 341–343, *April*, 1938.—It is shown that the point of application of the obligatory motion in the experiments of Melde and Kundt is at a displacement " node " in the driven medium. The word " node " means a point of minimum amplitude in the standing wave in the tube or string. This result agrees with that of Rayleigh but is obtained in a simpler manner. The discussion is presented briefly to make the results more available as current textbooks indicate a nearly universal misunderstanding of these two well-known experiments. AUTHORS.

2099. Velocity of Sound in Air. T. J. Kukkamäki. *Ann. d. Physik,* 31. 5. *pp.* 398–406, *March,* 1938.—The velocity of sound was determined from observations made with sound waves which started simultaneously in opposite directions along the same course. The distances chosen varied from 883 to 1319 m. and, of three series of measurements, two were made on land and one on a frozen lake (Lehijärvi) in S. Finland. The sound was made by setting off 1 kg. of high explosive. From a knowledge of the speed and direction of the wind a correction of the second order was made on each observation, and the final result for the speed of sound in dry, still air at 0° C. is given as 330·77 ± 0·064 m./sec. The speed in CO_2-free air is reckoned at 330·79 m./sec. Comparing the above value with previous ones the author concludes that for explosive sounds of frequency less than 1000, the velocity under the given conditions is 330·8 ; for higher frequencies it is 331·7 m./sec. G. E. A.

2100. Velocity of Sound in Single Crystals of Bismuth. A. B. Focke, R. B. Lindsay and C. R. Wilks. *Acoustical Soc. of America, J.* 9. *pp.* 348–351, *April*, 1938.—The velocity of compressional waves in single crystals of Bi of two orientations (P_1 and P_3) of the principal axis has been measured. The specimen to be tested (around 10 cm. in length) is inserted between two longer steel rods, one of which is driven by a loud-speaker coil while the other has a free end. The velocity is computed from the observed distance between two nodes when all or part of the crystal is included between them. For the P_1 and P_3 orientations the velocities are found to be 2028 m./sec. and 1541 m./sec., respectively, and the corresponding Young's moduli come out to be $4\cdot043 \times 10^{11}$ dynes/cm^2. and $2\cdot245 \times 10^{11}$ dynes/cm^2. AUTHORS.

2101. Dispersion of Supersonic Waves in Liquids. A. K. Dutta. *Phys. Zeits.* 39. *pp.* 186–187, *March* 1, 1938.—Employing the method of Debye and Sears, the author has measured the distances between diffraction bands produced by different liquids under the same conditions. With toluol and water there was a gradual increase in the ratio of the band distances with increase of frequency. From the results it is inferred that the velocity of sound in water increases by $1\cdot5$ per 1000 when the frequency increases from 3×10^6 to 3×10^7, and that within this range the velocity in toluol is constant. The abnormal dispersion in water is apparently due to the complicated structure of water and the group formation of its molecules. G. E. A.

2102. Birefringence of Liquids Produced by Supersonic Waves. R. Lucas. *Comptes Rendus,* 206. *pp.* 827–828, *March* 14, 1938.—A rotation of the plane of polarisation of plane polarised light passing through certain liquids occurs when supersonic waves are present in the liquid. The optical effect is a maximum when the plane of vibration of the light is inclined at 45° to the plane of the supersonic waves, the effect being zero when the plane of vibration of the light is parallel or perpendicular to the plane of vibration of the supersonic waves. Liquids in which the effect was observed include castor oil and linseed oil. A simple theory is given which is based on the close connection between this effect and the birefringence of liquids in a state of laminar flow. An expression for the path difference between the ordinary and extraordinary ray passing through the liquid is deduced and is given in terms of various constants of the liquid and the intensity per unit of surface of the supersonic waves. The order of magnitude of the observed effect agrees with that calculated. K. M. C.

2103. Absorption of Supersonic Vibrations in Solid and Liquid Media. N. F. Otpushtshennikov. *Phys. Zeits. d. Sowjetunion,* 12. 6. *pp.* 736–744, 1937. *In English.*—A description of the method developed by the writer and some results of the absorption of supersonic oscillations in solid and liquid media are given. This method has several advantages over other methods. The values for the coefficient of absorption of the supersonic oscillations differ considerably from the results obtained by other writers. Of the four liquids under investigation water has the least, and vaseline oil the largest absorption of supersonic oscillations ; qualitatively this may be explained by the viscosity coefficient of vaseline oil being greater than that of water. The absorption coefficient of supersonic oscillations computed by the Stokes formula greatly differs from the experimental values. AUTHOR.

2104. Limits of Audition for Bone Conduction. N. A. Watson. *Acoustical Soc. of America, J.* 9. *pp.* 294–300, *April,* 1938.—The laboratory facilities and apparatus described in an earlier paper [see Abstract 5411 (1937)] were used to study the normal intensity and frequency limits of audition for bone conduction. The conditions of the observer's head to give greatest acuity for pure tones, and the optimal total force of application and area of the vibrator button were found to be essentially the same as for speech sounds. Acuity was found to vary with the position of application of the vibrator ; for example, the maximum variation with position of the 1000 ∼ threshold was 18 db. A threshold for open canals was determined for the frequency range 80–2000 ∼, without interference from stray air radiation (18 normal observers). Above 2000 ∼ air radiation interfered with open canal tests to such an extent that a special technique was devised to obviate its effects. The occluded threshold curve, for a single individual, lay below his open canal curve over the range 80–2000 ∼, and also at 10,000 ∼. The usuable intensity range for open canals was tentatively determined; it is a maximum of 80–90 db at 1000–2000 ∼. The total audible frequency range for open canals was found to be at least 25–17,000 ∼. AUTHOR.

2105. Absorption of Sound in Carbon Dioxide. A. van Itterbeek and P. Mariëns. *Physica*, 5. *pp.* 153–160, *March*, 1938. *In English.*—An earlier paper [see Abstract 4628 (1937)] describes measurements of the absorption of supersonic sound in O_2, H_2 and CO. The experiments are now extended to CO_2. The absorption in this gas is markedly influenced by impurities especially water vapour. By using the method of preparation described by Eucken, CO_2 is obtained sufficiently pure to avoid marked effects of this kind. The absorption is measured as a function of pressure at 4 different temperatures between − 31·0 and 51·3° C. and at frequencies of 304 and 599 kc./sec. The relaxation time is inversely proportional to the pressure, and the absolute values agree with those of Eucken. It is concluded that the results are in agreement with Kneser's theory. From the values of the relaxation times the number of efficient collisions is calculated. K. M. C.

2106. Influence of a Magnetic Field on the Absorption of Sound in Oxygen. A. van Itterbeek and L. Thys. *Physica*, 5. *pp.* 298–304, *April*, 1938. *In English.*—Measurements are carried out on the absorption of sound as a function of pressure at 20° C. and 50° C. in O_2 placed in a magnetic field (maximum field-strength 6 kG.) of which the lines of force are perpendicular to the direction of motion of the sound waves. A great decrease is found (about 20% at 1 atm.). The influence decreases with decreasing pressure and disappears completely at room-temperature at a pressure of about 0·3 atm. At 50° the effect disappears at a lower pressure. A possible explanation of the effect is given by an influence of the magnetic field on the vibrational state of the O_2 molecule. The velocity of sound in O_2 is not influenced by the magnetic field. Measurements are also carried out on N_2 at room-temperature. The absorption of sound of this gas is not influenced by a magnetic field. The absorption of sound in N_2 as a function of pressure is in complete agreement with the formula of Kirchhoff-Helmholtz. AUTHORS.

2107. Absolute Sound Intensity in Liquids by Spherical Torsion Pendula. E. Klein. *Acoustical Soc. of America, J.* 9. *pp.* 312–320, *April*, 1938.—These experiments demonstrate the use of spherical radiometers to determine the energy density in an acoustic field. It is shown that the theoretical work of King [see Abstract 410 (1935)] is applicable to the measurement of radiation pressure in liquids. Considering the torsion pendulum as an absolute instrument, pressure microphones are calibrated as secondary standards. AUTHOR.

See also Abstracts 1813, 1814, 2013 and

1778B. Absorption of Sound by Porous Walls. A. F. Monna.
1779B. Absorption of System of Resonators. S. N. Rschevkin.
1780B. Prevention of Transmission of Sound along Water Pipes. J. E. R. Constable.
1781B. Transmission of Sound in a Building by Indirect Paths. J. E. R. Constable.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

∗2108. Null Methods of Calibrating Sensitive A.C. Instruments. W. Hohle and W. Rump. *Phys. Zeits.* 39. *pp.* 169–173, *March* 1, 1938.—Bridge arrangements used at the Physikalisch-Technischen Reichsanstalt for the calibration of ammeters and voltmeters at power frequencies are described. A standard voltmeter indicates the voltage across the bridge network. It is applied across a resistance potential divider and two other resistance arms, the one variable, the other fixed. For the calibration of an ammeter the instrument is inserted in series in the same arm as the variable resistance; in the case of a voltmeter it is connected in parallel with the fixed resistance. A vibration galvanometer connects the slider of the potential divider with the junction of the two resistance arms. A further refinement is introduced into the galvanometer circuit in the shape of a variable inductometer and a slide wire in order to balance the quadrature component, due to the small inequality in phase angle of the resistance arms, and so reduce the galvanometer deflection exactly to zero. The primary winding of the inductometer is connected in an auxiliary circuit coupled through a phase-shifting transformer to the same source of power as the main bridge network. The calibration is deduced in terms of the values of the fixed resistances and the reading of the standard voltmeter.
T. I. J.

∗2109. Calibration of Decade Condensers. L. H. Ford and N. F. Astbury. *Journ. Sci. Instruments,* 15. *pp.* 122–126, *April,* 1938.—The note describes an application of the Schering capacitance bridge to the calibration of decade condensers for capacitance and power factor.
Authors.

See also Abstract 2130 and
1540B. Impedance and Energy Relations in Networks. H. W. Bode.
1660B. Extension of Thevenin's Theorem. H. Ataka.

CONDUCTION AND DISCHARGE IN GASES.

2110. Energy Balance for an Infinitely Small Electron Current in a Uniform Electric Field. F. M. Penning. *Physica,* 5. *pp.* 286–297, *April,* 1938. *In English.*—For very low values of E/p_0 (field strength/gas density) the energy transfer in elastic collisions is important, and may be treated to a certain extent with the classic laws for mechanical collisions. At higher values of E/p_0, however, the conduction of electricity through gases is governed wholly by the laws of quantised energy transfer between electrons, molecules and excited molecules, for which Max Planck in 1900 laid the foundations.
Author.

2111. Force on Kathode of a Copper Arc. R. M. Robertson. *Phys. Rev.* 53. *pp.* 578–581, *April* 1, 1938.—The force on the kathode in the electric arc, previously examined either in air at atmospheric pressure or in a vacuum, is studied as a function of pressure. For the Cu arc in N_2 the force is found to remain of the order of magnitude of the values observed in air down to a pressure of about 5 mm., and then to increase sharply but smoothly to the much larger forces observed in a vacuum. Various aspects of the arc are examined in this transition region. Curves showing force as a function of current at various pressures of H_2 and N_2 are given.

A brief study of the stability of the vacuum arc is included, as well as a summary of the various theories put forward to explain the phenomenon. AUTHOR.

2112. Negative Ions in Discharge Tubes. K. G. Emeleus and J. Sayers. *Roy. Irish Acad., Proc.* 44*A*. 7. *pp.* 87–100, *Jan.*,1938.—It is pointed out that a number of finer details in the behaviour of gas discharges are connected with the presence of negative ions of molecular dimensions. Experiments show that the effects of negative ions can be demonstrated by adding Cl to a Ne discharge. The evidence produced seems to indicate that the formation of striations is probably connected with the presence of negative ions. A discharge containing heavy negative ions will behave like one containing only electrons and positive ions at higher pressures ; there is a tendency to set up regions of resultant negative space charge, or if these are already present to make them thinner. The distribution of negative electricity in the plasma will not be governed by the Boltzmann relation. The processes responsible for the destruction of negative ions in the gas phase are considered mainly on the basis of the quantum theory of Massey and Smith. An attempt is made to find the equilibrium concentration of negative ions, and the surface conversion of positive to negative ions is considered. The theoretical considerations put forward were used in the design of a tube to produce concentrated beams of negative ions. The tube is described, and is stated to produce beams up to nearly 10^{-8} A with energy down to 25 V. J. E. R.

2113. Ion Layer around a Probe in a Low Pressure Discharge. V. Polin and S. Gvosdover. *Phys. Zeits. d. Sowjetunion,* 13. 1. *pp.* 47–54, 1938. *In English.*—The results are described of experiments on the ion layer around a cylindrical incandescent tungsten probe placed in a mercury vapour discharge. The experiments consisted in determining the density distribution of the primary high speed electrons around the probe. It is shown that on increasing the current of ions flowing on to the probe the ion layer becomes more symmetrical. AUTHORS.

2114. Theory of Probes in Gases at High Pressures. F. Borgnis. *Ann. d. Physik,* 31. 6. *pp.* 497–504, *March,* 1938.—Langmuir and his collaborators have given a comprehensive theory applicable to probes in gases, the treatment of the motion of the electricity carriers being carried out under the assumption that within the Langmuir layer surrounding the probe the carriers undergo no impacts [see Abstract 1003 (1928)]. An investigation is here made of the relation between the potential U of a plane probe in plasma, the probe current density i and the Langmuir layer thickness d, for the case where the impacts of the carriers with gas molecules within the layer are considerable. It is sought to obtain certain qualitative conceptions of the transfer region between the undisturbed plasma and the actual layer. The results are applied to the case of the Hg vapour plasma. It is found that the relation sought has an order of magnitude given by the formula $U^2 = 8/9 \cdot id^3/l\Delta$, where l is the mobility and Δ the dielectric constant. A. W.

2115. Effect of Variations of Probe Conditions on the Langmuir Probe Characteristic. W. P. J. van Berkel. *Physica,* 5. *pp.* 230–240, *April,* 1938. *In German.*—For determining the probe characteristic of a stationary gas discharge a static method is usually employed, the probe potential being slowly varied stepwise. Each value of the probe potential is therefore kept constant for a certain length of time required for one observation. It is found that when the same probe potentials are used the value of the reciprocal of the observation time (called the observation *tempo*) has an effect on the value of the probe current obtained. Measurements were carried out for the homgeneous positive column of a discharge in neon and the observation *tempo* was varied between the limits 0·05 sec.$^{-1}$ and 3·0 sec^{-1}. Theory is developed which enables the results thus obtained to furnish the corrections which must be applied in order to determine the correct probe characteristic. A. W.

2116. Emission of Radiation in the Positive Column of a Mercury Arc. B. T. Barnes and E. Q. Adams. *Phys. Rev.* 53. *pp.* 545–555, *April* 1, 1938.—Intensities, corrected for absorption, of the principal spectral lines 2259 to 11289 Å are given for 4-ampere mercury arcs operated at vapour pressures of 0·03, 20, 450, and 500 mm. (Hg). The variation across the arc of the intensity per unit area is given for 20 of these spectral lines. Plots of spectral intensity data were made on two alternative hypotheses: (1) That the concentrations of atoms in excited states are in a Boltzmann equilibrium with one another and that transition probabilities are proportional to $w_{AB}/[\lambda^2(n_A^* + n_B^*)(n_A^* - n_B^*)^2]$, where w_{AB} is the Kronig *a priori* probability, λ is the wave-length of the emitted radiation, and n_A^* and n_B^* are the effective quantum numbers of the upper and lower levels; (2) that all downward transitions are radiative and that the rate of excitation to a given level is proportional to the product of the *a priori* probability of the level and the concentration of electrons with energies which do not differ from the minimum for excitation by more than a constant amount. A Maxwellian distribution of velocities was assumed. The method of plotting is such that, if either hypothesis were correct and if the corrections for absorption were of the proper magnitude, the points on the corresponding plot would all fall on a straight line. Characteristic deviations of the points from a linear relationship are found on each type of plot. Both types of plot indicate that the electron temperature varies little with distance from the axis. This is in disagreement with Elenbaas' theory of the mechanism of a high pressure mercury arc. [See following Abstract.] AUTHORS.

2117. Mechanism of Positive Column in Mercury Vapour at Intermediate Pressures. E. Q. Adams and B. T. Barnes. *Phys. Rev.* 53. *pp.* 556–562, *April* 1, 1938.—Calculations based on the radiant intensity for the principal spectral lines of 4-ampere mercury arcs at 450 mm. and 500 mm. (Hg) pressure, indicate for low quantum states a dynamic equilibrium with electrons at approximately 6000° K., the temperature indicated by the absolute spectral intensity for three reversed lines. For high quantum states differing only in total quantum number, there appears to be a tendency toward Boltzmann equilibrium due to collision with normal atoms at approximately the temperature (2500° K.) calculated from the heat balance by Langmuir's theory of conduction and convection in gases. This agrees with predictions from the principle of spectroscopic stability. [See preceding Abstract.] AUTHORS.

2118. Positive Column Characteristic of the Low-Pressure Discharge and its Significance as Regards Individual Discharge Processes. R. Rompe and M. Schön. *Zeits. f. Physik*, 108. 5–6. *pp.* 265–278, 1938.—The significance is discussed of the characteristic of the positive column of the low-pressure discharge as regards the elementary processes occurring in the discharge and their part in the power conversion. Effective and false power are distinguished. For these the inverse processes required by thermodynamics (impacts of the second kind, recombination, etc.) are of primary importance. The various elementary processes are arranged in cycles and an investigation is made for a simplified model of the low-pressure discharge (constant current strength across the section and electron temperature independent of the current strength) of the parts of the effective and false power belonging to each cycle. Losses at the walls of the discharge tube due to heat conduction and to ambipolar diffusion currents are considered in their bearing on the gradient and thermal equilibrium. A. W.

2119. Resistance of Vacuum Sparks. V. H. Sanner. *Zeits. f. Physik*, 108. 5–6. *pp.* 288–294, 1938.—Condenser discharges between electrodes with small separations in vacuum have been investigated by means of a kathode-ray oscillograph, the quenching resistance of the discharge circuit being estimated. It is shown that immediately after the discharge starts the resistance of the spark is extremely small but rises rapidly. With Al and Cu electrodes the resistance 50 μ.sec. after starting the spark was 0·01 ohm, and with C electrodes the value was 0·03 ohm. The total discharge time was from 100 to 125 μ.sec. J. E. R.

2120. Discharges in the Rare Gases. R. Schade. *Zeits. f. Physik*, 108. 5–6. *pp.* 353–375, 1938.—A full account is given of research on discharges in the rare gases and in particular on the effect of current density. A short account of this work has been given in a previous paper [see Abstract 810 (1938).] A. W.

2121. Self-Sputtering of the Kathode in Glow Discharge. H. Fischer. *Zeits. f. Physik*, 108. 7–8. *pp.* 500–508, 1938.—The return of sputtered material to the kathode is demonstrated directly by observation of the " shadows " cast upon the kathode by obstructions of glass or metal when the discharge is being run in H_2 or He. Alterations of the kathode surface due to sputtering have no effect on the γ-coefficient. L. A. W.

2122. Cumulative Excitation of Atoms in a Low Pressure Mercury Discharge. W. Fabrikant, F. Butajewa and I. Zirg. *Phys. Zeits. d. Sowjetunion*, 13. 1. *pp.* 23–31, 1938. *In English.*—The rôle of cumulative excitation in the general mechanism of atomic excitation in a low pressure Hg discharge has been quantitatively investigated. In agreement with the results of absorption measurements strict proportionality is established between the number of cumulative excitation acts and the square of the electron concentration. [See also Abstract 4642 (1937).] AUTHORS.

2123. Coefficient of Volume Ionisation for Pure Neon and Neon-Argon Mixtures. I. I. Glotov. *Phys. Zeits. d. Sowjetunion*, 13. 1. *pp.* 84–102, 1938. *In English.*—An approximate theoretical evaluation of the coefficient of volume ionisation α for pure Ne and Ne-A mixtures is given: the dependence of the coefficient α on the concentration of the A admixture is found. The results are in good qualitative agreement with the writer's earlier experimental data, as well as with Druyvesteyn's theoretical data. [See also Abstract 294 (1938).] AUTHOR.

2124. Dissociation of Ethane by Electron Impact. J. A. Hipple, Jr. *Phys. Rev.* 53. *pp.* 530–533, *April* 1, 1938.—The dissociation of C_2H_6 by electron impact has been investigated with a new mass spectrometer. One negative, two doubly-charged and fourteen positive ions have been observed corresponding to the various states of dissociation of the C_2H_6 molecule. An analysis is given of the processes taking place in the upper mass-range where unique interpretations of the results may be made. The difficulty of accurately determining the relative intensities of two ions having a large difference in mass is discussed as well as the meaning of the probable errors given for the measured appearance potentials. AUTHOR.

See also Abstracts 1911, 1963, 1964, 1966 and
1489B. Corrosion of Metal by Corona. A. Güntherschultze and H. Betz.
1496B. Corona Discharge from a Point. R. Venisi.
1497B. Influence of Admixture on B.D.V. in Argon. S. K. Moralew.

CONDUCTION IN SOLIDS AND LIQUIDS.

2125. Interaction between Closed Circuits Carrying Steady Currents. M. Wolfke. *Helv. Phys. Acta*, 11. 2. *pp.* 156–158, 1938. *In French.*—Following a paper by Piccard [see Abstract 5423 (1937)] the author puts forward the theorem that, although the law of the equality of action and reaction does not appear to be true in the case of the force between two current elements, nevertheless it holds for closed circuits composed of these elements. A short mathematical analysis leads to the conclusion that the resultant of the forces between two circuits is zero, hence it is supposed that the force exerted by the first circuit on the second is equal and opposite to the force exerted by the second circuit on the first. K. M. C.

2126. Approximate Treatment of Electrons in a Crystal Lattice. O. Klein. *J. de Physique et le Radium*, 9. *pp.* 1–12, *Jan.*, 1938.—The motion of an electron in a periodic field is discussed. The more general problem, including the interaction between the electrons, is then discussed by the method of the second quantisation and it is shown that Pauli's principle applies only to electrons with the same spin direction. The problem can be approximately treated by means of the Hartree-Fock approximation. R. P.

2127. Electronic States of Divalent Metals. K. Ariyama. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 768. *pp.* 344–356, *March*, 1938. *In German.*—According to the electronic theory of metals the valency electrons of the divalent metals belong to two energy bands which energetically overlap. Under the assumption that the over-lapping is small and that the gaps in the lower band as also the electrons in the upper band behave as approximately free electrons, a determination has been made of the degrees of freedom of the electronic states, number of electrons in a completed shell, etc. of the formula for the conductivity at high temperatures, the Hall-coefficient and the change of resistance in a magnetic field, and of the corresponding (semi-empirical) measurements for Be, Mg, Na, Cd and Hg. The magnetic susceptibilities calculated by means of the above constants introduced into the formula of Pauli and Peierls agree dimensionally with the experimental data. H. H. Ho.

***2128. Inverse Valve Voltmeter. O. H. Schmitt.** *Journ. Sci. Instruments*, 15. *pp.* 136–137, *April*, 1938.—A valve voltmeter is described which, by utilising the inverse characteristics of an ordinary triode valve, permits direct reading of voltages in the ranges 10–20000 V. directly on the scale of a milliammeter without draining current from the circuit under test. AUTHOR.

***2129. Absolute A.C. Measurements and Calibration of Thermocouples up to 500 Mc./sec. M. J. O. Strutt and K. S. Knol.** *Physica*, 5. *pp.* 205–214, *April*, 1938. *In English.*—The absolute measurement of a.c. at frequencies up to 60 Mc./sec. is effected by means of diode voltmeters and known impedances; this measurement, which was accurate to about 1% at 60 Mc./sec., showed that at that frequency thermocouples of various types keep within 2% of their d.c. calibration. At frequencies up to 500 mc./sec. calibration of thermocouples and absolute measurement of current were effected with a wire heater air thermometer, as used by A. Scheibe. With this instrument in a Lecher wire system currents of a few mA could be measured to 5% at 500 Mc./sec. and to 1% at 325 Mc./sec. The errors of the thermocouples tested also lay within these limits. P. V.

2130. Electrical Resistance of Selenium at High Field Strengths. F. P. Henninger. *Ann. d. Physik*, 31. 4. *pp.* 337–364, *Feb.*, 1938.—The resistance of Se is measured by the single-spark method of Wien for condenser voltages ranging from 0·1 to 110 kV. The resistance varies rapidly with voltage, a diminution of 50% being observed for a voltage increase from 2 to 12 kV. From a few kV up to 60 kV the resistance of plates of Se falls off as a linear function of the logarithm of the voltage, but at higher field strengths the fall is slower. At the highest voltages values in the neighbourhood of 500 ohm.cm. are observed. The effect of temperature is marked, the resistance having a low temperature coefficient at high voltages and a high temperature coefficient at low voltages. For control purposes, a ballistic bridge method is used and agreement with the single-spark method is obtained at high voltages. Blocking-layer Se rectifiers are also investigated and the results compared with those for Se plates. L. A. W

***2131. Bridge Potentiometer for Comparing Electric Resistance Standards. M. Romanowski and M. Picard.** *Comptes Rendus*, 206. *pp.* 594–596, *Feb.* 21, 1938.—One source of current is supplied to two branches of resistances, and, by using a stepped shunt which can be joined across two parts of the branch containing known resistances, the total resistance of the circuit is maintained constant. By adjusting the points of application of the shunt, the standards to be compared can be found correct to a thousandth part of an ohm in resistances of 10 ohms or larger. H. M. B.

***2132. Valve Amplifier for Weak Currents. F. Bedeau and L. Herman.** *Comptes Rendus*, 206. *pp.* 592–594, *Feb.* 21, 1938.—An iron-hydrogen valve is used to regulate the heating currents of two identical valves, the filaments of which are indirectly heated to prevent any current fluctuations which would cause instability, and measurements are made with a differential galvanometer. Resistances are placed in the plate and grid circuits, the latter steadies the current, but at the same time rather cuts down the sensitivity. H. M. B.

***2133. Differential Amplifier. J. F. Toennies.** *Rev. Sci. Instruments*, 9. *pp.* 95–97, *March*, 1938.—Describes an input stage for an amplifier designed, in connection with biological work, for the measurement of the p.d. between two points each of which is at a high potential relative to earth. Two triodes can be used, or two pentodes. In the latter case, the gain in effective amplification is offset by a slight fall in accuracy. Normally operated stages, earthed at one point in the usual way, can be used after the differential input-stage. An accuracy of 0·1% is claimed for voltages up to 20 V. [See also Abstract 2837 (1937).] N. F. A.

***2134. D.C. Mains Voltage Stabiliser. R. J. Hercock.** *Phot. J.* 78. *pp.* 146–149, *March*, 1938.—A voltage stabiliser supplying 30 mA is described which operates over a range of 220–260 V; a 20V variation of input produces approximately a 0·001V change in the output which is 150V. The circuit is described in four stages (1) the barretter, (2) the thermionic valve, (3) a filter network and (4) the gas discharge tube, the final circuit being obtained by combining all four. R. L.

2135. Resistance of Metals under Pressure. P. W. Bridgman. *Am. Acad., Proc.* 72. *pp.* 157–205, *Jan.*, 1938.—The author deals at length with the change of electrical resistance of metals with pressure up to pressures of 30000 kg./cm.^{2} thus extending his previous work where pressures of only 20000 kg./cm.^{2} were attained. The development of a new type of apparatus is described which involves the principle of the application of pressure externally to the pressure chamber to compensate partially for the effect of the internal pressure. The results are given in detail for 19 metals including two orientations of single crystals of Zn, Sn, Sb and Te. With only one exception the resistance of all metals when plotted against pressure (as abscissæ) shows upward curvature. No theoretical discussion of the results is offered. R. L.

2136. Electrical Resistance of Gold Below 1° K. W. J. de Haas, H. B. G. Casimir and G. J. van den Berg. *K. Onnes Lab., Leiden, Comm. No.* 251*C. Physica,* 5. *pp.* 225–229, *April,* 1938. *In English.*—The resistance of gold was determined at temperatures below 1° K., obtained by adiabatic demagnetisation of iron-ammonium-alum. The increase observed at ordinary liquid He temperatures is much more pronounced below 1° K. and the present results suggest that the resistance may become infinite at the absolute zero-point. AUTHORS.

2137. Contact Capacity between Metals and Semiconductors. G. Dechêne. *Comptes Rendus,* 206. *pp.* 828–830, *March* 14, 1938.—The contact p.d. at the surface between a metal and a semiconductor when a current is passed is attributed to a capacity at the surface, shunted by the contact resistance. These contact capacities are found for a number of semiconductors of different resistivities. The method used is to measure by means of a kathode-ray oscillograph the rate of growth of a current through a semiconductor provided with metallic electrodes ; a formula is given relating the rate of growth with the contact capacity and contact resistances. The contact capacities are higher the lower the resistivity of the semiconductor : figures are given for yellow oxide of mercury. The nature of the semiconductor is also important, for example the capacities per cm^2. of electrode are several times higher for this oxide of mercury than for Na_2CO_3. The importance of these results in the theory of contact rectifiers is pointed out. K. M. C.

2138. Theory of Supraconductivity. F. London. *Zeits. f. Physik,* 108. 7–8. *pp.* 542–544, 1938.—In reply to a paper by Bopp [see Abstract 1282 (1938)] it is pointed out that although the equations of H. and F. London are in agreement with the concept of an infinite conductivity, their conditions are more restrictive and rule out many possible field distributions which would be compatible with infinite conductivity, but never occur in actual experiments. R. P.

2139. Motion of Supraconductors. N. Felici. *Comptes Rendus,* 206. *pp.* 599–601, *Feb.* 21, 1938.—By using the principle that both the electric and the magnetic field vanish inside a supraconductor, and the principle of relativity, some results about the behaviour of supraconductors in motion are derived. R. P.

See also Abstracts 1865, 2108, and

1522B. A.C. Electrometer. H. B. Brooks, F. M. Defandorf and F. B. Silsbee.
1523B. H.V. Measurements by Transformer Method. F. B. Silsbee and F.M. Defandorf.
1526B. Conductivity. G. A. Percival.
1535B. Wheatstone Bridge Deflection Method. K. Melzer.

DIELECTRICS AND CAPACITANCE.

2140. Dielectric Constant of a Gas under High Pressure. M. Kubo. *Chem. Soc., Japan, Bull.* 13. *pp.* 167–173, *Jan.*, 1938. *In German.*—According to the Debye dipole theory, the molecular polarisation of polar compounds in the gaseous or vapour state is composed of a constant optical term and dipole term dependent on temperature but not on pressure. The present paper contains a discussion of the deviations of the Debye expression at high pressures in connection with certain experimental data, and a mathematical theory is developed to account for the reciprocal effect of the dipoles. H. H. Ho.

2141. Existence in Liquids of Intermolecular Coupling of the Second Kind. A. Piekara. *Zeits. f. Physik*, 108. 5–6. *pp.* 395–400, 1938.—The author has proposed a theory in which two kinds of intermolecular coupling forces are considered, and this has been applied to N. N. Pal's data [see Abstract 221 (1931)] for the molecular polarisation in nitrobenzene solutions. The coupling forces of the second kind arise only casually in the immediate vicinity of the molecule considered, whereas those of the first kind are bound up with the state of order in the liquid. The very good agreement with Pal's data contrasted with the lack of agreement found by F. H. Müller [see Abstract 3854 (1937)] for the same series of measurements when only coupling of the first kind is taken into account, points to the important part played by coupling of the second kind in intermolecular action. The application of the theory is briefly discussed with respect to the interpretation of the so-called positive saturation-effect. H. H. Ho.

2142. Effect of Hydrostatic Pressure on the Susceptibility of Rochelle Salt. D. Bancroft. *Phys. Rev.* 53. *pp.* 587–590, *April* 1, 1938.—The electric susceptibility of Rochelle salt has been studied as a function of both temperature and hydrostatic pressure. Both the upper and lower critical temperatures are altered by the pressure, but the pressure coefficients for the alterations are different in the two cases. An attempt is made to correlate the experiment with statistical mechanical theory, but it is found that the theory is not sufficiently explicit to provide a quantitative explanation of the results. AUTHOR.

2143. Dielectric Polarisation in Liquids in Asymmetric Fields. F. H. Müller. *Wiss. Veröff. a. d. Siemens-Werken*, 17. 1. *pp.* 20–37, 1938.—The effect of asymmetric electric fields on the dielectric constant of polar and non-polar liquids is considered, and it is deduced that it is not appreciably affected by such fields. E. R.

See also Abstracts 1928, 2049, 2109, 2197 and
1503B. Dielectric Loss in Polar Liquids and Solids. S. O. Morgan.
1505B. Physics of Dielectric Loss. P. O. Schupp.

ELECTROCHEMISTRY.

2144. Radius of Copper Ion in Solutions of Cupric Benzenesulphonate. M. Quintin. *Comptes Rendus*, 206. *pp.* 663–664, *Feb.* 28, 1938.—The diameter ($2a$) of the cupric ion, as deduced by Debye and Hückel's formula from the results obtained with the cell Cu amalgam (2 phases) | $Cu(PhSO_3)_2 \cdot c$ | KCl, satd. | KCl, 0·1–N | Hg_2Cl_2, Hg would appear to decrease from 8·0 for c (gm.mol./l.) $= 0 \cdot 1$ to 1·2 for $c = 0 \cdot 005$, and to be negative for lower values of c. The formula therefore does not apply in this case. That of la Mer, Gronwall and Greiff [see Abstract 280 (1932)] leads to a constant value $a = 6 \cdot 9$ Å for $c = 0 \cdot 001$ or less, and is almost certainly valid for higher concentrations. The radius of Cu^{++} is, however, almost certainly greater in the benzenesulphonate than in the sulphate. [See Abstract 1808 (1937).] C. A. S.

2145. Overvoltage. A. L. Ferguson and S. Kleinheksel. *J. Phys. Chem.* **42.** *pp.* 171–190, *Feb.*, **1938.**—A large amount of previous work is summarised, dealing with the overvoltage phenomena of different surfaces of a number of metals. By means of an oscillograph and new equipment it is possible to distinguish between an internal resistance drop and an electrode potential decay even on smooth Pt. The method is applied to platinised and smooth Pt, Pd, Au, Ag, Zn, Cd, Sb and Ni. [See Abstract 2251 (1935).] F. J. B.

2146. Mechanism of Overvoltage. M. Loschkarev and O. Essin. *Acta Physicochimica,* 8. 2. *pp.* 189–204, 1938. *In German.*—The nature of the expression for the hydrogen overvoltage is discussed for the case where the stages of discharge and recombination simultaneously determine the velocities of the electrode processes. The equation derived by Hammet is converted into a more convenient form, and the experimental data for H_2 and Br_2 found to be satisfactorily represented by it. The more general case is then investigated, where three or more stages of the electrode process (*e.g.* discharge, recombination, two-dimensional diffusion of the molecular H_2 and its desorption) have comparable velocities. It is established that the general form of the expression, which follows for the case where the recombination stage immediately succeeds that of discharge, is identical in form with that obtained for the two-stage process above. When intervening stages occur, such as desorption of atomic H with succeeding recombination in the gaseous phase, the formula has to be somewhat modified. The possibility of a similar relationship between the velocities of the different stages of metallic ion discharge is investigated, and the equation is derived for the case where the retarded discharge and the formation velocity of the crystal lattice simultaneously determine the polarisation. H. H. Ho.

2147. Mechanism of the Hydrogen Electrode Process. Parts I and II. J. Horiuti, G. Okamoto and K. Hirota. *Chem. Soc., Japan, Bull.* **13.** *pp.* 216–233, *Jan.*, 1938. *In English.*—In Part I experimental evidence is submitted for a catalytic mechanism with special reference to the Ni electrode, and under the assumption that the adsorbed H atoms are practically non-polar and that the H_2 electrode processes comprise an isotopic interchange reaction. From the catalytic mechanism, the electrode current should behave peculiarly when the electrode potential is suddenly raised or lowered, and this behaviour has been experimentally confirmed. In Part II an experimental verification is given of the existence of the hydrogen molecular ion at the electrode-solution surface. H. H. Ho.

***2148. Glass Electrode for pH Measurements with Small Amounts of Solution. Y. Kauko and L. Knappsberg.** *Zeits. f. Elektrochem.* **44.** *pp.* 261–263, *April,* 1938.—With the customary spherical glass electrode of radius about 1 cm. it has not been possible hitherto to carry out pH determinations with small volumes of solution. Experimental results are adduced to show that such determinations can be carried out with a film of solution adhering to the glass or held in gauze material surrounding it, conducting connection being obtained by a thread or strip of filter-paper. L. A. W.

2149. "Normal Potential" of Deuterium. E. Abel and O. Redlich. *Zeits. f. Elektrochem.* **44.** *pp.* 204–205, *March,* 1938.—The various definitions of "normal potential" adopted by different workers in the case of D_2 are discussed. L. A. W.

2150. Activity Coefficient and Mean Ionic Diameter in Solutions of Mixed Electrolytes. H. I. Stonehill. *Faraday Soc., Trans.* 34. *pp.* 533–554, *April*, 1938.—The activity coefficient of $CdSO_4$ in the presence of added salts (X) has been determined at 25° and 30° C. by measuring the e.m.f. of the cell Cd, Hg (2-phase amalgam)$|CdSO_4(c_1) + X(c_2)$, $PbSO_4$ (sat.)|Pb, Hg (2-phase amalgam), the added salt being in turn KNO_3, KCl, K_2SO_4, $MgSO_4$, $Mg(NO_3)_2$ and $La_2(SO_4)_3$. Mean ionic diameters for the mixed electrolyte solutions have been calculated from the activity coefficients, using both the Debye-Hückel and the La Mer equations, and two concentration scales, molarity and molality. The ionic diameters are independent of the concentration scale employed and also have a zero or very small negative temperature coefficient. The Debye-Hückel equation leads to variable and often negative ionic diameters, and is thus unsatisfactory. The La Mer equations lead to exclusively positive ion diameters, which however are not in agreement with formulae based on the assumption that these ionic diameters for mixed electrolytes have a physical relation to either crystallographic diameters of individual ions or La Mer mean ionic diameters for single electrolytes. The Hückel modification of the Debye-Hückel equation allowing for change of dielectric constant with concentration, and the hypothesis of incomplete dissociation are both inadequate to account for the failure of the Debye-Hückel equation. Bjerrum's ion-association theory leads to ionic diameters for $CdSO_4$-$MgSO_4$ mixtures which have the same defects as the La Mer ionic diameters, while for $CdSO_4$ or $ZnSO_4$ singly the Bjerrum ionic diameters vary with concentration. AUTHOR.

See also Abstract

1491B. Orientation of Crystallites in Electrolytic Cu. V. Montoro.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2151. Ring Structure of the Electron. B. S. M. Rao. *Phys. Zeits.* 39. *pp.* 187–189, *March* 1, 1938.—J. Stark has put forward the theory that the spinning electron can be replaced by an electron with ring structure obeying classical mechanics [see Abstract 2767 (1937).] This point of view is criticised and it is shown that, even allowing for the alterations to Maxwell's equations suggested by Born, the ring-like electron together with classical electrodynamics leads to contradictions with experiment. G. C. McV.

2152. Fundamental Unit of Electric Charge. H. T. Flint and W. Wilson. *Phys. Soc., Proc.* 50. *pp.* 340–344, *May* 2, 1938.—A generalisation of the uncertainty relationships for the case in which an electromagnetic field is present is developed. It is further shown that the atomicity of electric charge is a consequence of the integral relationships which are a feature of the quantum theory. AUTHORS.

2153. Influence of Adsorbed Gases on Secondary Electron Emission from Metals. P. Colombino. *N. Cimento,* 14. *pp.* 529–531, *Dec.,* 1937.—The previous experiments [see Abstract 4359 (1936)] are modified in such a way that the specimen is kept at a definite temperature long enough to establish stationary conditions. The coefficient of secondary electron emission is then measured as a function of the temperature.

It is found that it decreases very rapidly as the temperature is raised to about 170°, but from there onwards remains approximately constant.
R. P.

2154. Energy Loss of Fast Charged Particles by Pair Creation. M. Kobayasi and S. Ozaki. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers. No.* 766. *pp.* 321–331, *Feb.*, 1938. *In English.*—Using the method of William and Weizsäcker, it is shown that heavy electrons lose a considerable part of their energy by pair production. At energies greater than 10^4mc^2, where mc^2 is the rest mass of an ordinary electron, the energy loss by pair production becomes much more important than the energy loss by ionisation. F. C. C.

2155. Energy Absorption from Fast Kathode Rays. K. Gentner. *Ann. d. Physik,* 31. 5. *pp.* 407–424, *March,* 1938.—Apparatus is described in which kathode-rays of 25·6 kV. are scattered from thin metal foils and their velocity and angular distribution measured by the method of the magnetic spectrum. All the experiments were carried out on Al foils of thicknesses from 1 to 6 × 10^{-4} cm. Curves showing the relative energy and number of electrons absorbed by an increase of 5μ in the foil thickness show very marked maxima at a foil thickness equal to about ¼ of the range. The apparatus is designed so that by using 3 collecting electrodes the distribution of back and forward scattered electrons can be examined. A number of curves are given in which these distributions are analysed in detail. J. E. R.

2156. Absorption of High Energy Electrons. Part III. A. J. Ruhlig and H. R. Crane. *Phys. Rev.* 53. *pp.* 618–621, *April* 15, 1938.—Losses in lead of electrons with energies both above and below the range previously used (2 to 11 eMV) have been measured. For the low energy group electrons from radioactive P^{32} were sent through lead laminae of two thicknesses placed in the centre of a cloud chamber. In this energy region the losses in lead should be due almost entirely to ionisation processes. The experimental values for the energy losses are from 2 to 4 times those given by the Bloch formula. For the high energy group the electrons and positrons produced by the Li + H^1 γ-radiation were used. The values found are about 50% greater than the calculated losses due to ionisation and radiation, but are in good accord with the previous experimental values. [For Part II see Abstract 4691 (1937).] AUTHORS.

2157. Absorption of Slow Neutrons in B and Li and the 1/v Law. F. Norling and R. Fleischmann. *Zeits. f. Physik,* 108. 7–8. *pp.* 483–490, 1938.—Using neutron indicators of Dy, Rh, Ag, Mn, I and Br, examination is made of the absorption coefficients of B and Li for slow neutrons. A linear relation is found to exist between mass absorption coefficient and neutron energy and both elements therefore follow the 1/v law. The ratio of the coefficients is constant and equal to 5·5; the ratio of the absorption cross-sections is about 8·6. F. C. C.

2158. Collisions of Fast Neutrons with Protons. T. Kahan. *Comptes Rendus,* 206. *pp.* 742–744, *March* 7, 1938.—The cross-section for a collision between a fast neutron and a proton is calculated, assuming current views about the interaction force. The cross-section depends on whether the spins of the two particles are parallel or opposite, being about 4 times larger for the former case than for the latter. R. P.

2159. Scattering of Slow Neutrons in a Crystal Lattice. I. Pomerantschuk. *Phys. Zeits. d. Sowjetunion,* 13. 1. *pp.* 65–83, 1938. *In English.*—The probability of elastic and inelastic scattering of slow neutrons in a crystal lattice is determined. The capture of slow neutrons and the inelastic scattering are compared. At $k\Theta \gg E \gg kT$ (E energy of the neutron, Θ Debye temperature of the lattice) the capture of the neutrons becomes considerably greater than the inelastic scattering and therefore thermal equilibrium between the neutrons and the crystal lattice cannot be reached. AUTHOR.

***2160. Limits of Resolving Power of the Electron Microscope. M. v. Ardenne.** *Zeits. f. Physik*, 108. 5–6. *pp.* 338–352, 1938.—A resolving power of 10^{-5} mm. has recently been attained with the Ruska magnetic electron microscope and the limiting resolution of the light microscope has thereby been exceeded by more than ten times. Consideration is given to the various aberrations of the magnetic electron microscope with a view to estimating the limits of its resolving power. The diffraction error and the aperture error of the objective have magnitudes which vary in opposite sense in dependence on other parameters and a limit is thereby set to the resolving power which, for an accelerating voltage of 50000 V and an objective of normal dimensions is about 10^{-6} mm. The attainment of this limit is made difficult if not actually prevented by the existence of chromatic aberration due to fluctuation of the accelerating potential, the distribution of electron velocities and differential retardation of electrons in the object layer and the object supporting foil. This limit can in practice only be approached in investigating the thinnest specimens and by the most careful elimination of fluctuation of the magnetic fields. Numerical values of the individual and total aberrations are presented in tabular form. In conclusion quantitative consideration is given to the factors upon which contrast is dependent in the electron microscope. J. E. K.

2161. Electron-Optical Kathode Imagery in a Gas Discharge. H. Mahl. *Ann. d. Physik*, 31. 5. *pp.* 425–442, *March*, 1938.—An electron-optical image of a cold kathode may be obtained by means of ionic bombardment. An electron microscope is described which is used to investigate the discharge conditions for various gas fillings. An account is given of the effect of the gas on the brightness and the definition of the image of the kathode and the conditions necessary for the production of the best image for a given gas pressure and for a given potential are discussed. The intensity of the image may be increased by the use of an auxiliary magnetic lens which enables good images to be obtained at a lower potential. A number of applications of the method are illustrated. H. J. H. S.

See also Abstracts 1864, 1908, 1963, 1964, 1972, 1975 and
1532B. Kathode Phase Inversion. O. H. Schmitt.
1749B. Intensity Control of Electron Beams. S. Recknagel.

ELECTROSTATICS.

***2162. Electrostatic Generator Operating Under High Air Pressure—Operational Experience and Accessory Apparatus. D. B. Parkinson, R. G. Herb, E. J. Bernet and J. L. McKibben.** *Phys. Rev.* 53. *pp.* 642–650, *April* 15, 1938.—A description is given of experience gained in operation of the Wisconsin electrostatic generator [see Abstract 906 (1937)] with particular reference to the use of CCl_4 and CCl_2F_2 and to the problem of the fire hazard. Improvements in the charging belt system and the accelerating tube are discussed; and generator equipment, including the generating voltmeter, the voltage stabiliser and the ion source, is described. AUTHORS.

See also Abstract 1974.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2163. Variations of Resistance of Electric Conductor in a Magnetic Field. F. van Bergen. *Comptes Rendus*, 206. *pp.* 588–590, *Feb.* 21, 1938.—From consideration of the combined force due to an electric field H and a magnetic field *h* a law of the same form as Ohm's law is derived, namely, $r'J = H$, where J is the current density and $r' = R(1 + h^2/h^2_0)^{\frac{1}{2}}$, R being the resistance. This expression for r' is shown to be in better agreement with the experimental results of Kapitza for Mg at 78° K. than either Sommerfeld's formula, $(r' - R)/R = A\,h^2$ or that of Franck $(r' - R)/R = A\,h^2/(1 + B\,h^2)$. R. W. P.

2164. Thermomagnetic Properties of Ag-Cd and Cu-Cd Systems. N. Perakis and L. Capatos. *J. de Physique et le Radium*, 9. *pp.* 27–36, *Jan.*, 1938.—An account of the magnetic properties of the complexes $S_2O_8(Ag_x\,Cd_y\,4\,C_5H_5N)$ and $S_2O_8(Cu_x\,Cd_y\,4\,C_5H_5N)$. Between ordinary temperature and that of liquid air, these complexes follow the Weiss law for a wide range of concentration. In mixtures very poor in Cu and Ag a displacement of the Curie point takes place. Graphs of moment/concentration and Curie point/concentration have the same form in both systems. With mixtures rich in Cu and Ag (up to 50%) the moment varies little with the concentration. In the free state, the moments of the ions Ag″ and Cu″ are 9·11 and 9·78 respectively. The equality of the moments of Ag″ and Cu″ is attributed to the effect caused by solution. In dilute solutions, Ag and Cu become trivalent. At a certain dilution the moment increases very rapidly and tends towards 14 magnetons (2·83 Bohr magnetons), which is the theoretical moment of the ions Ag‴ and Cu‴. With very great dilution Ag and Cu become paramagnetic with a constant susceptibility $\chi_{Ag} = +1{\cdot}242 \times 10^{-6}$, and $\chi_{Cu} = +1{\cdot}595 \times 10^{-6}$. Ag and Cu when dissolved in Cd both behave in the same way. [See also Abstract 3748 (1937).] G. E. A.

MAGNETISM AND ELECTROMAGNETISM.

2165. Application of General Cylindrical Functions in Electromagnetic Theory. S. S. Stefanescu. *Bull. Math. et Physique*, 8. 1–3. *pp.* 168–173, 1936–1937. *In French.*—The following problem is discussed: A current of unit intensity flows in the equal sides of an isosceles triangle; a current of intensity *n* flows in the base of the triangle. Determine the lines of the magnetic field in the median plane of the triangle. The solution is obtained in terms of Bessel and Neumann functions. Special cases are discussed. J. S. G. T.

2166. Domain Theory of Ferromagnetics Under Stress. Part II. W. F. Brown, Jr. *Phys. Rev.* 53. *pp.* 482–491, *March* 15, 1938.—From the general formulæ of Part I [see Abstract 4197 (1937)] expressions are derived for the magnetostriction of polycrystalline Fe and Ni when the domains are isotropic, and when they are crystalline and have [111] or [100] as the direction of easy magnetisation. The effect of assuming uniform strain rather than uniform stress is discussed. For Fe at room temperature the experimental data fit the theoretical curve over a limited range; the deviations at high and low magnetisations can be explained qualitatively. For Ni at temperatures from 6° C. to the Curie point, excellent agreement is found between theory and experiment. The analysis indicates that for the specimen studied, the domains are polycrystalline at low temperatures, but become smaller than the crystals at a little below

200° C., where the direction of easy magnetisation becomes [100]. From the measurements at the higher temperatures, values are obtained for the saturation magnetostriction of Ni crystals magnetised in the [100] direction; from these and the saturation magnetostriction of polycrystalline nickel, values for the [111] direction are calculated. AUTHOR.

2167. Collective Electron Ferromagnetism. E. C. Stoner. *Roy. Soc., Proc.* 165*A*. *pp*. 372–414, *April* 14, 1938.—After discussing the relation between previous work and the present work on this subject, the author, on the basis of Fermi-Dirac statistics determines the form of the magnetisation-temperature curves for energy bands of standard type and for a range of values of the exchange interaction energy. The theory is developed to cover paramagnetism above the Curie point as well as ferromagnetism below that temperature. Results corresponding to classical statistics are given, for comparison. Theoretical results are in very good agreement with experimental results relating to Ni, Fe and Co; a residual discrepancy may be attributable to the neglect of domain effects. J. S. G. T.

2168. Susceptibility of Cerium. R. Jaanus. *Phys. Zeits. d. Sowjetunion,* 12. 6. *pp*. 729–735, 1937. *In English*.—An approximate expression for the dependence on the field of the magnetic susceptibility of a ferromagnetic inclusion in a weak magnetic sample is given. The conditions necessary for the strict control of the absence of ferromagnetic inclusions in the sample and for the determination of the true susceptibility of the basic substance of a sample which includes ferromagnetic impurities, are established. Doubt is expressed as to the correctness of susceptibility values previously reported for Ce at low temperatures. [See also Abstract 2259 (1937).] AUTHOR.

2169. Magnetic Properties of Tellurium on Colloidalisation. M. Prasad and S. S. Dharmatti. *Indian Journ. Phys.* 11. *pp*. 393–398, *Jan.,* 1938.—The magnetic properties of colloidal powders of metallic elements exhibit an apparent change in susceptibility the cause of which has not been definitely established. Various methods of powdering Te result in a change of susceptibility of the metal, from which the authors conclude that the size of the particle has no bearing on the change of susceptibility. The change is ascribed to impurities formed by the absorption or adsorption of gases. This view is supported by the fact that the original susceptibility is regained when the powders are washed with cold dilute acid. G. E. A.

2170. Magnetic Properties and State of Ionisation of Atoms in Alloys. G. Foëx. *J. de Physique et le Radium,* 9. *pp*. 37–43, *Jan.,* 1938. —The paramagnetic susceptibilities of intermetallic compounds of Si with Fe, Ni, Co, Cr and Mn are measured. From the data conclusions can be drawn as to the state of ionisation of the magnetic atoms. R. P.

2171. Free Radical of a New Type. Paramagnetism of the Perchlorate of Tritolylamménium. P. Rumpf and F. Trombe. *Comptes Rendus,* 206. *pp*. 671–673, *Feb*. 28, 1938.—The magnetic susceptibility of the perchlorate of amménium (non-saturated ammonium) $[(CH_3 \cdot C_6H_4)_3N]^+ClO_4^-$ has been determined. The fact that it has an unpaired electron and is paramagnetic makes it a free radical. After correction for the diamagnetism of the perchlorate group and for the paramagnetism of the air, a value for the paramagnetism of the free radical is obtained in good agreement with that evaluated from van Vleck's theory of magnetism. W. R. A.

2172. Diamagnetic Anisotropy of an Aromatic Molecule. C. F. Squire. *Comptes Rendus*, 206. *pp.* 665–667, *Feb.* 28, 1938.—The theory of London [see Abstract 4205 (1937)] has been extended and the anisotropy of a molecule consisting of seven benzene nuclei is calculated. The value is only slightly greater than that given by London for a molecule consisting of four nuclei, and is only about one-quarter the value obtained on the basis of the semi-classical theory of Pauling. W. R. A.

2173. Diamagnetic Anisotropy of Conjugated Compounds. K. Lonsdale. *Chem. Soc., J. pp.* 364–368, *March*, 1938.—In order to extend quantitative knowledge of crystal susceptibilities to different types of conjugated compounds, data are given for metal-free phthalocyanine, oxalic acid dihydrate, stilbene, tolan, and *trans*-azobenzene. These have been correlated with the available X-ray data for the molecular direction cosines in order to obtain the principal susceptibilities of the molecules. The anisotropy of the oxalate group is about twice that of the carbonate radical and about one-sixth of that of benzene. Stilbene and tolan possess, not only the expected anisotropy normal to the molecular plane, which may be explained in terms of molecular orbitals, but also a considerable anisotropy *in* that plane, which is not yet explained. It is shown that large diamagnetic anisotropy is associated with the existence of bond resonance (mesomerism), plane arrangement of atoms in the molecule and tendency to equalisation of bond distances, not only in closed rings (as predicted by theory) but also in open systems. AUTHOR.

2174. Diamagnetic Polarisabilities of the Benzene Molecule. H. König. *Zeits. f. Physik*, 108. 5–6. *pp.* 391–394, 1938.—The Cotton-Mouton constants for benzene vapour have been utilised to calculate the diamagnetic polarisabilities of the molecule. Results are compared with experimental recorded values for benzene as a liquid and divergences are explained on the basis of association in the liquid state. W. R. A.

2175. Magnetically Neutral Solutions. C. Salceanu. *Zeits. f. Physik*, 108. 7–8. *pp.* 439–443, 1938.—The concentrations at which aqueous solutions of 16 paramagnetic salts become magnetically neutral have been determined. The ratios of the Weiss magnetons of a pair of solutions is equal to the square root of the inverse ratio of the concentrations for which these solutions are magnetically neutral. W. R. A.

2176. Magne-Crystallic Action. Part V. Paramagnetic Salts of the Rare-Earth and the Iron Groups. K. S. Krishnan and A. Mookherji. *Roy. Soc., Phil. Trans.* 237*A*. *pp.* 135–159, *March* 29, 1938.—An account is given of measurements on the magnetic anisotropy and the mean susceptibility of a large number of paramagnetic crystals, among which are several salts of the rare earths, many of the Fe group, and some feebly paramagnetic salts. The results are discussed, on the basis of the theory of van Vleck, Penney and Schlapp, in relation to the Stark-splitting of the energy levels of the paramagnetic ions under the influence of the strong crystalline electric fields acting on the ions. A detailed calculation is given of the constants of the crystal field in the Ni salts. The striking contrast in the magnetic behaviour of the six-coordinated and the four-coordinated Co compounds, predicted by the theory, is verified experimentally. The former salts are strongly anisotropic magnetically, while the latter are only feebly so. The mean susceptibilities of the former deviate more from the " spin only " value than those of the latter. All the salts of the Fe group, except those of Co, have two of their principal susceptibilities nearly equal; *i.e.*, the magnetic ellipsoids of these crystals approximate to a spheroid. The conclusion drawn from studies on the absorption spectra of some of the rare-earth salts that the fields acting on the rare-earth ions in these crystals should be almost cubic in symmetry is not supported by observations on the magnetic anisotropy of these crystals. [For Part IV see Abstract 4377 (1936)]. AUTHORS.

2177. Purification and Magnetic Properties of Mercury. L. F. Bates and C. J. W. Baker. *Phys. Soc., Proc.* 50. *pp.* 409–412, *May* 2, 1938.—Differences between the magnetic properties of several specimens of Hg prepared by the Hulett method [see Abstract 84 (1912)] were removed by subsequently heating the mercury *in vacuo* at 260° C. for some time. The temperature variation of the mass susceptibility of Hg so treated was measured and the results are discussed with reference to a theory given by Stoner [see Abstract 330 (1936)]. AUTHORS.

2178. Equations of Electromagnetism. Part I. Identifications. Part II. Field Theory. E. A. Milne. *Roy. Soc., Proc.* 165*A*. *pp.* 313–357, *April* 14, 1938.—The purpose of these two papers is to ascertain the form of the equations of electromagnetism when derived on a purely kinematic basis, without assuming Maxwell's theory. The only physical assumption made is that a system of moving charges conserves its energy when the accelerations of the charges vanish. In Part I the most general type of external forces, after gravitational forces, which are encountered in the study of the dynamics of a particle in a smoothed-out universe is discussed. A force which, for the present epoch and at small distances, reduces to the Larmor-Lorentz formula for the ponderomotive force on a moving charge is identified, and a scalar multiplier is identified as charge. The relativistic equations of motions of two charged particles in one another's presence are derived, and Coulomb's inverse square law is deduced in exact relativistic form. The law expressing the magnetic field at a distance from a moving electric charge contains the velocity of the test charge measuring the field, and agrees with results found by Uhlenbeck and Goudschmidt and by Thomas. In Part II, it is shown that the concept of an electromagnetic field (E, H) existing in free space, independent of the circumstances of the test-charge used to measure it, must be abandoned and replaced by a field (E, H) depending on the velocity of the test charge. Two of the "field identities" derived coincide with Maxwell's equations while the remaining two are modifications of the remaining two Maxwell equations. They imply wave-propagation of E, H and admit the existence of a vector potential. Electromagnetic energy is calculated mechanically. Radiation occurs in certain cases of accelerated motion but not for periodic systems. The field is the mechanism for conveying energy between sets of charged particles. J. S. G. T.

2179. Magnetostriction of Ferromagnetic Substances due to Quadripole Forces. T. Hirone. *Tohoku Univ., Sci. Reports*, 26. *pp.* 282–296, *Dec.*, 1937. *In English. Report No.* 431 *of the Research Inst. for Iron, Steel and other Metals.*—The magnetic energy of a lattice consisting of magnetised atoms differs from the energy of a lattice of magnetic dipoles, owing to the finite extension of the atoms. The difference can be partly taken into account by considering the quadripole moments of the atoms as well as their dipole moments. The result of the calculation is that, with reasonable figures for the atomic diameters, the quadripole forces are quite comparable with the dipole terms. However, the quantitative results for the magnetostriction, which are obtained in this way do not agree well with the experiment. R. P.

See also Abstracts 1789, 1851, 2068, 2106, 2127, 2164, 2201.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2180. Oscillographic Study of the Cerebello-Cerebral Relationships. A. E. Walker. *J. Neurophysiol.* 1. *pp.* 16–23, *Jan.*, 1938.—Excitation of the cerebellar hemispheres produces a marked increase in the amplitude and frequency of the cortical action potentials from the motor areas of the cat. Section of the superior cerebellar peduncle abolishes the response of the contralateral motor cortex but a slight change in the potentials of the ipsilateral motor cortex may still be elicited. From these experiments it is concluded that the cerebellum, especially the neocerebellum, exerts a stimulating influence upon the cerebral cortex, which may be the mechanism through which the cerebellum normally maintains a coordinating influence upon volitional movement. AUTHOR.

2181. Human Brain Potentials during the Onset of Sleep. H. Davis, P. A. Davis, A. L. Loomis, E. N. Harvey and G. Hobart. *J. Neurophysiol.* 1. *pp.* 24–38, *Jan.*, 1938.—A more detailed account of this work. [See Abstract 359 (1938).]

2182. Electrical Signs of Biological Activity. H. S. Gasser. *J. of Applied Physics*, 9. *pp.* 88–96, *Feb.*, 1938.—An account is given of recent attempts to analyse the potential changes in the active region of sensory nerves during and after stimulation. In addition to potential changes, propagation, resistance and polarisability have been investigated. An attempt is made to correlate potential effects with heat evolution and metabolic changes. A large amount of evidence is reviewed and a tentative hypothesis of the sequence of events in nerve stimulation is put forward. J. E. R.

2183. Depth Effects in Roentgenograms. A. B. Meservey. *Am. J. of Roentgenology and Radium Therapy*, 39. *pp.* 439–449, *March*, 1938.—The subject of stereoscopic vision is generally discussed in respect to the visual impression of depth. Similar factors apply in respect to X-ray films, although these are not important for trained observers, when viewing single films but may lead to distorted effects when small rotations of stereoscopic films are present. Examples are shown of errors which may exist when metallic bodies are viewed in conjunction with X-ray films, the metal appearing erroneously placed behind the skeletal object, when actually it is in front and vice versa. To obviate such errors, the use of pseudoscopic views is advocated, with avoidance of relative rotation of the films. Generally stereoscopic depth effects predominate over other depth effects, but the latter can in practice give rise to spurious appearances. B. J. L.

2184. Soft Tissue Radiography. J. R. Carty. *Radiology*, 30. *pp.* 417–419, *April*, 1938.—The technique of soft tissue radiography demands far more attention to detail then is required for ordinary examinations. The choice of voltage is critical and the lowest voltage consistent with adequate penetration should be used. Under most conditions 300 mA. sec. is an optimum value. Films should be chosen to given considerable latitude, together with maximum contrast over a wide range of densities; fog on films seriously affects the diagnostic value of soft tissue films. It is necessary to do the development by sight, routine time and temperature development being unsuitable. In the examination of films a variation in the quality of illumination is very valuable. J. E. R.

2185. Sharpness of Shadows in Radiography of the Lungs. R. R. Newell. *Radiology*, 30. *pp.* 493–499, *April*, 1938.—The author discusses relationship of exposure time to sharpness of X-ray shadow and arrest of movement for radiography of the chest. He uses a new criterion of sharpness, namely, the visibility of the small pulmonary vessels (idealised). He gives relationship between permissible loadings on the focal spot to the degree of sharpness attainable. Unsharpness varies inversely with the cube root of tube loading (mA per mm.^{2} apparent focal spot). X-ray tubes with stationary anode are incapable of resolving 0·5 mm. pulmonary vessels set 0·25 mm. apart and moving 5 mm. per sec. With present apparatus the best arrest of lung detail moving 5 mm. per sec. is with 1 mm. focal spot on a rotating anode, 1/40 sec., 200 mA at 1 m. distance. To use 2 mm. focal spot, 500 mA, at 2 m. is almost as good, and might be preferred on account of better detail in bones and lesser magnification of heart shadow. AUTHOR.

2186. Wave-Length as a Factor in Radiotherapy. G. F. Stebbing. *Brit. J. of Radiology*, 11. *pp.* 177–182, *March*, 1938.—The arguments in favour of the use of the hardest available radiations in the treatment of deep seated malignant disease, are summarised. Small increases in per cent depth doses are valuable when combined with the use of multiple field techniques. It is further suggested, however, that on the basis of clinical evidence, the radiosensitiveness of normal and neoplastic tissues irradiated in the human body become more widely separated as the wave-length of the radiation used decreases. J. E. R.

2187. Dosage System for Interstitial Radium Therapy. R. Paterson and H. M. Parker. *Brit. J. of Radiology*, 11. *pp.* 252–266, *April*, 1938.—A dosage system for interstitial radium therapy, consisting of dosage graphs and distribution rules expressed in terms of mg.-hr. per 1000 r, is described. The system falls into two sections: (1) Single plane and two-plane implantations, which are operated from the same graph. (2) Volume implantations, treating any volume of tissue considered as a simple geometrical form. A separate graph is provided for this method. Tissue tolerance, including local tolerance to implantations, calculated by this system, is discussed, and practical applications of the method are given in detail. AUTHORS.

2188. X-Ray and Radium Protection. *Radiology*, 30. *pp.* 511–515, *April*, 1938.—Report of the revised recommendations of the International X-ray and Radium Protection Commission at the Fifth International Congress of Radiology, Chicago, Sept., 1937.

See also Abstracts

1619B. Action of Electricity upon the Body. A. K. Krüger.
1620B. Electric Shock. G. Burnet.

OSCILLATIONS AND WAVES.

***2189. New Form of Frequency and Time Standard. L. Essen.** *Phys. Soc., Proc.* 50. *pp.* 413–423; *Disc.*, 423–426, *May* 2, 1938.—A description is given of a new form of quartz oscillator, designed to give a high frequency-stability under conditions of operation demanding little attention. It consists of a cylindrical quartz ring whose mean radius is about 2·7 cm., oscillating in an overtone longitudinal mode at a frequency of 100 kc./sec. The elastic wave round the circumference has six nodes, and the ring is supported at three of these nodes so as to be located with almost geometric precision with respect to the electrodes, with no constraints acting on it except those due to its own weight. Since the mean circumference of the ring remains unchanged during the vibration there is little air damping, and strong oscillations are obtained at atmospheric pressures. The temperature coefficient of frequency depends on the difference between the internal and external radii of the ring and can be reduced to zero at a particular temperature, the average coefficient being less than 1 part in 10^6 per 1° C. for temperatures 15° C. above and below that value. The frequency-stabilities of two equipments are given. An oscillator at room-temperature and atmospheric pressure, and not maintained in continuous operation, gives a stability of $\pm$ 5 parts in 10^9 during periods of an hour, and $\pm$ 1 part in 10^7 during weekly periods. An oscillator maintained in continuous operation in an evacuated container at a controlled temperature, and used as a standard of time, gives a stability of $\pm$ 4 parts in 10^{10} during hourly periods, and 1 part in 10^8 during monthly periods. AUTHOR.

2190. Polar Molecules and Radio Waves. M. C. Holmes. *Frank. Inst., J.* 225. *pp.* 309–314, *March*, 1938.—The effect of the earth's electric field on a water molecule is considered. Such a polar molecule will experience a force tending to bring it into vertical alignment, from which position it will oscillate much like a torsional pendulum. From known values of constants, the frequency of such oscillators is calculated; it varies with height above the earth's surface and corresponds with that of short radio waves. Deviations from the frequency, calculated in this simple way, owing to collisions with air molecules and thermal effects are considered. It is shown how for a frequency of 10^5 kc./sec. a wave travelling through such a medium would be reduced to 37% of its initial amplitude in a distance of 3600 cm. Such a medium will also show an effect analogous to anomalous dispersion, the refractive index changing in sign. Such a change could give rise to reflection of the waves from that particular layer. G. G.

2191. Constitution of the Ionosphere and the Lorentz Polarisation Correction. H. G. Booker and L. V. Berkner. *Nature*, 141. *pp.* 562–563, *March* 26, 1938.—According to Ratcliffe [see Abstract 2292B (1933)] the equivalent height for reflection of the extraordinary wave in the ionosphere (at places where the angle of dip lies between certain values), should increase to infinity for a wave frequency less than the gyrofrequency if the Lorentz polarisation term is retained in the magneto-ionic theory. If, however, the term is omitted, the equivalent height should tend to infinity at the gyrofrequency. Automatic records taken at Kensington, U.S.A., show the equivalent height rising to infinity at 1·38 Mc./sec., while reasonable assumptions regarding the change of dip with altitude give the gyrofrequency as 1·54 Mc./sec. at 100 km., and 1·44 Mc./sec. at 250 km. The majority of the wave retardation occurs at a low level in the E-region, and the records show that the retardation of waves reflected back and forth between the E- and F-regions is almost independent of frequency. While it is very difficult to explain these results if the Lorentz term is omitted, they are explicable when the term is allowed, provided the molecular ion-density in the lower part of the E-region is 10,000 times the electron density. Reference is made to Martyn and Munro [*ibid.* 141. *pp.* 159–161, *Jan.* 22, 1938] whose opposite interpretation of similar records is adversely criticised. J. P. A.

2192. Ionospheric Observations : Eclipse of June 8, 1937. H. W. Wells, H. E. Stanton and S. L. Seaton. *Terr. Mag.* 43. *pp.* 37–40, *March,* 1938.—Special ionospheric observations conducted at Huancayo (Peru) and Watheroo (Western Australia) for the eclipse of June 8, 1937, show : (1) The day of the eclipse was normal, ionospherically. (2) No eclipse-effect for F-region critical frequencies at Huancayo. (3) The eclipse caused merging of the F_1- and F_2-regions, followed by normal conditions at sunset, more than an hour earlier than usual. The absence of any eclipse-effect in the F-region critical frequencies may be real or may be attributed to the fact that the eclipse did not occur at Huancayo until late afternoon. It is suggested that for such conditions ionising radiation from the sun would be greatly reduced by absorption in the earth's atmosphere before the beginning of the eclipse due to the large zenith-angle of the sun. AUTHORS.

2193. Ionisation, Negative-Ion Formation, and Recombination in the Ionosphere. N. E. Bradbury. *Terr. Mag.* 43. *pp.* 55–66, *March,* 1938.—The ionisation in the ionosphere is discussed in the light of present theories of recombination and negative-ion formation. It is suggested that the E- and F_1-regions are formed as the result of the absorption of special bands of solar radiation and that negative-ion formation is the predominant process in these regions. A sufficient number of electrons exists, however, to cause the reflection of electromagnetic waves. The F_2-region is probably not due to the absorption of any special band of solar radiation but owes its formation to the preponderance at this elevation of electron-positive-ion recombination over negative-ion formation during the day. The characteristics of the E- and F_1-regions are discussed quantitatively and compared with experimental observations. A qualitative discussion is given for the F_2-region since it seems probable that significant changes in level and density take place at these elevations. AUTHOR.

See also Abstracts 2013, 2132, 2133 and

1724B. Height of Ionosphere at Heiho, during 1936 Eclipse. T. Nakamura.
1726B. Characteristics of Ionosphere. Y. Asami and M. Saito.
1750B. Generation of Oscillations by an Electron Beam in the Field of a Plate Condenser. A. Recknagel.

PHOTOELECTRICITY.

2194. Resistance in Selenium Photovoltaic Cells. E. Elvegård, S. Lindroth and E. Larsson. *J.O.S.A.* 28. *pp.* 36–39, *Feb.,* 1938.—The resistance of a Se rectifier photo-cell was measured with a Wheatstone bridge under various illuminations for various values of the current (*i.e.,* photo-current plus current supplied by bridge battery) flowing in the cell. As the current increased from the extreme negative value used (the direction of the photo-current being regarded as positive) the resistance increased slowly, increased rapidly as it passed through zero, attained a maximum value and then decreased again. The greater the intensity, the lower was the resistance and the greater the current at which the maximum occurred. The temperature coefficient of the resistance, measured in the dark, was negative and depended on the current flowing. D. H. F.

***2195. Two Relays Incorporating Photo-Cells. A. Grace.** *Journ. Sci. Instruments,* 15. *pp.* 128–132, *April,* 1938.—Two relays are described which can be operated by a small deflection of a beam of light. The first relay, which incorporates one photo-cell, is of the simple " on " and " off " type, while the second, with two photo-cells, is of the " three-position"

type, the central position being neutral. Arrangements are described for using either of these relays to control a platinum-wound furnace.
Author.

***2196. Galena Light Detector. F. Fischer, B. Gudden and M. Treu.** *Phys. Zeits.* 39. *pp.* 127–134, *Feb.* 1, 1938.—An account is given of investigations of the e.m.f. produced by illuminating the contact between a metal point and PbS. Measurements are made on the dependence of the effect upon applied voltage, frequency of interruption of illumination, temperature, wave-length of incident light and pressure of contact. Some experiments are also carried out with gold electrodes deposited by evaporation. It is concluded that in addition to a photoelectric effect which is free from time lag there is also a thermoelectric effect, and that this accounts for the differences of opinion upon the phenomena expressed in the literature.
L. A. W.

See also Abstract 2198 and

1772B. Reproduction of Images by Photoconductive Effort. H. Miller and J. W. Strange.

1774B. Light Storing Television Tube. G. Krawinkel, W. Kronjäger and H. Salow.

PIEZOELECTRICITY.

2197. Relaxation Time in Rochelle Salt Crystals. Part II. R. D. Shulvas-Sorokin. *Phys. Zeits. d. Sowjetunion,* 12. 6. *pp.* 685–700, 1937. *In English.*—Measurements of the direct dynamic piezoelectric modulus have been made. The results of the measurements show the rôle of the piezoelectric deformation in the rise of the polarisation in Rochelle salt. The connection between the mechanical and the electrical time of relaxation is analysed and an attempt is made to picture the mechanism for the formation of the polarisation in these crystals. [For Part I see Abstract 1879 (1935).]
Author.

See also Abstracts 1942, 2142.

THERMIONICS.

2198. Photoelectric and Thermionic Investigations of Thoriated Tungsten Surfaces. A. King. *Phys. Rev.* 53. *pp.* 570–577, *April* 1, 1938.—Photoelectric and thermionic data were obtained over a wide range of temperatures for several activations of a thoriated W filament. The temperature dependence of the thermionic and photoelectric work functions are quite different. It is shown that this is to be expected for a non-uniform surface. The measured current density in either case is $i = (1/A)\int_s i_s ds$, in which i_s is given by either the Richardson-Dushman or the Fowler-DuBridge equation and A is the total emitting area. On the basis of a simple patch theory the integrations are carried out and show that (1) the saturation electron emission is independent of the size of the patches; (2) the observed or characteristic thermionic and photoelectric work functions for composite surfaces are different at low temperatures and approach each other at high temperatures: (3) the maximum and minimum values of the work function for a given surface do not vary linearly with temperature.
Author.

2199. Oxide-Coated Kathodes. Part I. Particle-Size and Thermionic Emission. M. Benjamin, R. J. Huck and R. O. Jenkins. *Phys. Soc., Proc.* 50. *pp.* 345–357, *May* 2, 1938.—The emission from an oxide kathode increases as the particle-size of the oxide decreases. It is shown that the smaller particles give a more uniform emitting surface and increase the ratio of emitting to non-emitting areas. The size of the oxide particles is determined by the method of preparation of the carbonates. The carbonate particles generally undergo no change of size in the process of conversion to the oxide state, but the method of preparation can cause particle-growth during conversion. AUTHORS.

See also Abstract 2128.

THERMOELECTRICITY.

2200. Thermo-E.M.F. of Graphite-Silicon Carbide Couple. M. Dodero. *Comptes Rendus*, 206. *pp.* 660–661, *Feb.* 28, 1938.—The e.m.f.-temperature curve of a C-SiC and a Cu-SiC thermocouple shows a break at about 900° on heating and about 700° on cooling, indicating an allotropic transformation of the SiC which is confirmed by expansion measurements. N. M. B.

2201. Influence of a Transverse Magnetic Field on the Thermoelectric Power of Nickel and Fe-Ni Alloys under Stress. G. Simon and J. Bouchard. *Comptes Rendus*, 206. *pp.* 667–669, *Feb.* 28, 1938.—The alloy under investigation, in the form of a filament, is brazed at each end to two Cu filaments and is mounted between the pole faces of an electromagnet; to the lower end of the compound filament is applied a stress. The alloy is in a uniform magnetic field. The general conclusions which can be drawn from the measurements are given in a preliminary form, showing the variation of the thermoelectric power as a function of the applied field, of the applied mechanical force, and of the temperature. The composition of the alloy has been found to have considerable effect on the results. It is concluded that thermoelectric power and magnetostriction have a common origin. W. R. A.

2202. Calculation of Heating of Conductors by Current or by Radiation. J. Fischer. *Zeits. f. techn. Physik*, 19. 2. *pp.* 25–30, 1938.—The differential equation representing the heating of a stretched linear conductor by electricity or by radiation is discussed. Information is then given as to the coefficients which are involved for wires of Fe, Ni, Pt and W, and which are required for the evaluation of surface losses either by radiation across an evacuated space, or for the case where this loss is assisted by convection and conduction into the surrounding medium. R. W. P.

2203. Surfaces of Vacuum Thermoelements. F. Kerkhof. *Ann. d. Physik*, 31. 4. *pp.* 315–336, *Feb.*, 1938.—The absorbing powers of various blackened surfaces were determined by reflection measurements in the regions 3100–4000 Å and 4100–7100 Å, but no difference was found for the absorbing powers in these regions. Camphor soot had the highest absorbing power, giving a value of $0{\cdot}984 \pm 0{\cdot}003$. Vacuum thermoelements with various blackened surfaces only showed slight differences in their radiation sensitivity. It was found that a selective u.v. sensitivity increase could be obtained by the use of bright metal surfaces, thus, for the wave-length 3130 Å, a silvered surface gave about 11 times the sensitivity of a lampblacked surface. With thin grey surfaces an almost uniform increase of the spectral sensitivity was obtained, an oxidised Bi surface giving a sensitivity about 2½ times that of a lampblacked surface. For gold surface layers the u.v. sensitivity was found to increase with film thickness, but for gold amalgams an optimum film thickness was observed. A. G. Q.

See also Abstracts 2129, 2196 and

1550B. Thermoelectric Probe for Measuring Gas Velocity. A. Sellerio.